RESOURCES & INDUSTRIES

May, 1945

MAY 21 1945

EDISON ELECTRIC INSTITUTE BULLETIN

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PUBLISHED MONTHLY BY EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

SOURCE AND DISPOSAL OF ENERGY

	JANUARY 1945	FEBRUARY 1945
GENERATION* (Net)		
By Fuel Burning Plants	13,822,432,000	12,112,828,000
By Water Power Plants	6,457,138,000	5,913,091,000
Total Generation	**20,279,570,000**	**18,025,919,000**
Add—Net Imports over International Boundaries	104,714,000	89,871,000
Less—Company Use	151,200,000	141,203,000
Less—Energy Used by Producer	384,499,000	.....
Net Energy for Distribution	**19,848,585,000**	**17,974,587,000**
Losses and Unaccounted for	2,218,613,000	1,174,542,000
Sales to Ultimate Customers	**17,629,972,000**	**16,800,045,000**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS		
Residential or Domestic	27,528,816	27,561,135
Rural (Distinct Rural Rates)	1,143,984	1,147,162
Commercial or Industrial:		
Small Light & Power	4,262,351	4,262,454
Large Light and Power	152,617	152,332
Other Customers	117,916	118,246
Total Ultimate Customers	**33,205,684**	**33,241,329**
KILOWATTHOUR SALES		
Residential or Domestic	3,171,590,000	3,051,744,000
Rural (Distinct Rural Rates)	206,762,000	217,778,000
Commercial or Industrial:		
Small Light and Power	2,708,322,000	2,642,046,000
Large Light and Power	9,754,377,000	9,314,901,000
Street and Highway Lighting	219,104,000	191,997,000
Other Public Authorities	721,396,000	701,091,000
Railways and Railroads:		
Street and Interurban Railways	495,657,000	420,632,000
Electrified Steam Railroads	254,873,000	220,777,000
Interdepartmental	97,891,000	39,079,000
Total to Ultimate Customers	**17,629,972,000**	**16,800,045,000**
Revenue from Ultimate Customers	**$295,187,200**	**$287,557,200**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For 12 months ended		
Kilowatthours per Customer	1,159	1,167
Average Annual Bill	$40.57	$40.73
Revenue per Kilowatthour	3.50¢	3.49¢

(*) By courtesy of the Federal Power Commission.

Vol. 13, No. 5, EDISON ELECTRIC INSTITUTE BULLETIN; published monthly. Entered as second-class matter Aug. 17, 1933, at the post office at Philadelphia, Pa., under the act of March 3, 1879. Publication office, 56th and Chestnut Sts., Philadelphia, Pa. Editorial office, 420 Lexington Ave., New York, N. Y. Subscription rate $2.00 per year in the United States; $3.00 per year in foreign countries.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 13 MAY 1945 No. 5

A Talk About the Company

With Some Good Home Spun Suggestions for Americans

By C. C. Curtis

President, Savannah Electric and Power Company

Remarks before the Rotary Club of Savannah

I GUESS I'm just about an average American and likewise an average Rotarian. One proof of it—if any were needed—is that I hate the thought of getting up in public or before a crowd and talking. I'm not a missionary or crusader and have no desire to make over other people into the mold into which I was cast. One is probably enough—very likely it is too many.

However, there are many things about which I have firm convictions, as do all of you. Mine may not be the same as yours, which is what makes the world interesting. That's one of the many good things about Rotary—it brings together men of varied interests with different outlooks on life, as influenced by the businesses or professions in which they are engaged. And incidentally, leaving myself out of it, I strongly believe in talks by members of Rotary on those subjects in which they are most interested—their own business or professional activities.

Mine for nearly 38 years has been the public utility business, at first for six months on construction work—which is tremendously interesting but with especially marked cycles of prosperity or depression—from that time on in the operation, management or business end of the game. My first job with an operating public utility was in December, 1907, when I went to the Ponce Railway and Light Company in Ponce, Porto Rico as Assistant Lighting Superintendent, a high sounding title, but it meant a job where I had charge of two Spanish speaking colored linemen with a line cart or wagon drawn by one big mule. I also tested meters—old cast iron Thompson high torque electric meters. They were usually installed in bath or bedroom of Porto Rican homes. My procedure was to rub the slats of the persianas, or blinds, on the front door —there were no glass windows in the houses—then when someone, usually the mistress of the house or a servant, opened the slats to see who was intruding, I would speak in my best Castillian style, one of the few Spanish words I knew at the time—Contador, meaning counter or meter.

Since I was an American, considered a little loco or queer because we worked with our hands and got dirty in the daytime and possibly the same night might be at a baile or dance in evening clothes, but also respected and trusted, I was admitted and shown the meter. The first thing was to disconnect the meter, then take it down from the wall, back to the meter shop, test and return to its place in the home. Many Porto Rican homes were beautiful and had plenty of lights, but others would have one 16 candlepower lamp—flat rate $1 a month. Shortly afterwards the new tungsten lamps came into production and many utility people were scared stiff, feeling the new lamps, taking one-half the current for the same amount of light, would reduce revenues to the point of disaster. But, of course, they didn't. Ever since that time continued improvements in lamps and all electrical equipment, together with continued reduction in rates, has brought the American public more and more electrical service—and better service—for less money. Of course, you sometimes hear people say their "light" bills are higher than they used to be. Generally speaking, that is true, but the electric service bill is no longer a "light" bill. It does include lighting and lots of it, but it also includes current for radio, iron, washing machine, refrigerator, toaster, cooking, hot water heating, room heaters, etc. No need for me to try to mention them all. I even overlooked fans, and you can think of many more.

I think one of our greatest obligations or responsibilities is to think straight and honestly. Never make promises we can't keep. Don't say one thing just to be nice and do something else because it is to our selfish interest to do so. Respect the rights of others. Try to do what we can on a broad scale, but spend most of our time and devote our best efforts to our own individual jobs. If each person does whatever daily work he has to do better than it could be done by anyone else, nothing much will be wrong with the country. Let's all once more resolve to think straight, live straight, be mentally honest, respect the rights of others, prefer peaceful ways, but when we have to fight, fight with all our soul, intelligently, unrelentingly until victory is won.

Recently in *Volt-Age,* our company monthly magazine, I asked employees to furnish records, if they could, going back over a period of years, showing for

the same month in each year kilowatt hours used, net bill and resultant cost per kilowatt hour. One of these was as follows:

Residential Service for Month of September — M. T. McKenzie, Isle of Hope, 1926 to 1934, and 309 East 35th Street, 1934 to 1944

Year	Used	Bill	Cost per KWH
1926	46	$4.14	.090
1927	69	4.01	.058
1928	88	4.59	.052
1929	87	4.33	.049
1930	253	9.56	.037
1931	206	8.62	.041
1932	313	11.08	.035
1933	405	12.71	.031
1934	217	6.64	.030
1935	281	7.74	.027
1936	345	9.04	.026
1937	291	8.19	.028
1938	465	10.71	.023
1939	408	8.80	.021
1940	360	8.16	.022
1941	356	8.16	.022
1942	358	8.04	.022
1943	364	8.21	.022
1944	360	7.83	.021
	(Nearly 8 times)	(Less than twice)	(Less than ¼)

Dear Sir:

"Here is the record of electric energy used at my house for the month of September each year since 1926.

"As you see, the cost per kilowatt hour has steadily dropped.

"Because of improvement in lamps, for each kilowatt hour we now get about 22 per cent more light than in 1926.

"Development of insulation, automatic control, efficient heating elements, such as the calrod, and other features afford an economy and reliability of operation in water heating, refrigeration and cooking, which taken with the lowered cost of the kilowatt hour gives us more and more for our money as time goes on.

"Not the least of achievements by our industry has been the lowered cost of ranges, refrigerators, water heaters and other appliances over the years.

"My family and I go all-out for the all-electric home and as you see by the record we've been that way a long time.

"Yours for the continuation of more and more electricity for less and less money."

(Sgd.) M. T. McKenzie

Advocates of government ownership of utilities usually talk of the low rates which are possible under that plan of operation—but they don't talk much of the subsidies which they often receive from the government itself, nor of the taxes which they don't pay. Very often they do pay something in lieu of taxes, but it is very small compared to the actual taxes which business-managed utilities pay.

In 1944 the Savannah Electric and Power Company had a gross revenue from both electric and transportation departments of a little over $5,000,000. Total taxes were $1,162,978. In other words, whatever else we did with the money we took in we first had to use over 23c. out of every dollar to pay taxes. We don't object to paying taxes as such—but we do object to any yardstick by which fair rates are to be measured when that yardstick is not accurate.

Another way of looking at it—in 1944, our taxes for the whole company, electric and transportation, were $1,162,978. We received from all our residential customers (26,231 as of Dec. 31, 1944) $1,190,858, just $27,880 more than total taxes. So you see, if there were some miraculous way of doing away with all taxes, it would just about enable us to have served our residential customers for nothing. But taxes must be paid—to help pay for the war to the limit of our capacity as we go along and thus keep the debt down as much as possible and so help prevent inflation.

Just one more comparison on taxes: Our total operating payroll in 1944 was $1,010,147, some $152,831 less than went to governmental agencies for taxes.

You've had your troubles during the war—so have we—but we're not complaining. Reports by the score, regulations, restrictions, blackouts, dimouts, brownouts, War Production Board, War Labor Board, National Labor Relations Board, OPA, ODT, Internal Revenue, Selective Service, War Manpower Commission, Federal Power Commission, Securities and Exchange Commission, Public Service Commission, War Bonds, Community Chest, Red Cross, and so on and on. Many of them are necessary, especially in war time—but, oh, what a headache at times! We're now dealing with three unions and get along all right. But all these things do take time. We changed over two boilers at the Power Plant so as to use coal instead of oil and then find coal has to be conserved by reason of its scarcity. In May, 1941, we entered into a contract with the Georgia Power Company so as to add to our firm capacity—instead of adding more generators in our Power Plant—and almost before the ink was dry on the contract were begged to hurry up construction of the line so we could send all the power we could generate up to the capacity of our generators so they in turn could help electric customers throughout the southeast during one of the worst droughts in years.

In 1941, stocks of electrical merchandise such as ranges, refrigerators, water heaters, toasters, waffle irons, fans, coffeemakers, etc., were speedily bought up by avid customers, and for over two years now we have had practically nothing of the sort to sell except electric globes. When manufacturers are again able to make such things there will be a tremendous demand, probably for several years.

Of course, the principal thing we have to sell anyway is Service, and we've tried to maintain a high standard on that even with all the war handicaps. We've tried to inspire every employee of the company to feel that now is a golden opportunity to work even harder than before and not make the war an excuse for letting down. One thing, too, it's important to remember, is that the actual electricity we deliver to our customers 24 hours a day is the same for rich or poor, mansion or hovel. We do not have deluxe electricity for those who can afford it and Grade "C" or "D" for those not able to buy the best.

Since early in 1942, we have been drastically restricted as to serving new customers—for some time practically nothing but war industries, war housing, etc. Regulations are very slightly eased at the present time—but materials are even less plentiful than before. One example: For about three weeks up to about ten days ago we were without a single meter which could be installed in the ordinary way for a new residential customer.

Fortunately we have been reasonably successful during the emergency in obtaining repair parts in quantities required for most electrical appliances. So the only alternative to getting new things seems to be to try to keep the old equipment on the job as long as you can by proper care and repairs when necessary and possible. One of the War Production Board's slogans certainly applies

to electrical appliances as well as to every other usable thing: "Make it do, use it up, wear it out" before trying to get a replacement.

Judging by the talk of some who claim so loudly to be solely or principally interested in the welfare of the people—or the common man—whoever that is—one might think the cost of electricity loomed large in the budgets of all. However, the facts don't support such an idea. Several years ago figures were published showing that for the country as a whole the average expenditure of the American family for household electricity was just about 2 per cent of that family's total budget. At present it most likely is still less because incomes are much greater and unit cost of electricity lower. Residential customers (26,231 as of Dec. 31, 1944) of Savannah Electric and Power Company in 1944 used an average of 1,581 kilowatt hours for the 12 months, much more than the national average—which was 1,142, at a cost of $45.93, equal to 2.9c. per kilowatt hour—much less than the national average of 3.5c. Increased use may be judged by the fact that in 1934 our residential customers (13,527 of them) used an average of 758 kilowatt hours (less than half the quantity in 1944) at an average cost of 4.7c. per kilowatt hour, as compared with 2.9c. in 1944.

In 1944 revenue from sales of electricity to all residential or domestic customers in the country amounted to $1,093,000,000.

Even in 1939 the Department of Commerce reported expenditures in that year by the American people for cigarettes alone amounted to $1,037,747,000. I haven't figures for later years, but you just know that they are much greater.

In February, 1945, the Department of Commerce stated that approximately $54 per capita was spent during 1944 in the United States for alcoholic beverages. Multiply this by 130,000,000 population and you would get something like $7,000,000,000. Just compare that with the paltry one billion dollars, plus, spent by residential customers of the United States for electricity.

OPA Chief Chester Bowles, in an Associated Press story from Washington appearing in the *Morning News*, March 14, 1945, was quoted as saying that the American people in 1944 spent $1,500,000,000 on movies.

People often seem to think cost of electric service looms large in the cost of manufactured goods. In a few, like electro-chemical and metallurgical processes, it does, but in most cases it does not. One example: The Southeastern Shipbuilding Corporation in Savannah, as you know, has been building Liberty ships. They started using electric power in April, 1942—and used lots of it—welding and everything else. Up to the end of 1944 they had launched 85 Liberty ships and commissioned 82. On the basis of official cost of ships, total cost of electric power for ships launched amounted to .569 of 1 per cent, or just a little over ½ of 1 per cent of the cost of the ships. For ships completely outfitted, the corresponding ratio was .59 of 1 per cent.

The future looms large before us. What are we going to do about it? No one can tell us everything that will happen, but of one thing I am sure—opportunity for the young man is just as great as ever before in the history of our country. A number of years ago many people were bemoaning the thought that there were no more opportunities—no more frontiers to conquer, thinking of the old days when our forefathers settled this country—many of them struck out on unblazed trails and conquered the wilderness. But what did that mean? It certainly meant hard work, long hours, straight thinking—sometimes privation, suffering, and often death fighting the desert or hostile Indians. Only the strong survived and prospered. Even before the war there were plenty of new frontiers to conquer, frontiers of science, electricity, chemistry, education, the moral code, human behavior, disease.

Anyone who ever thinks there is nothing more to discover, nothing more to invent, nothing more which can be thought of to raise still higher our standards of living and thinking is just not thinking straight. We have never reached perfection—we never will—but we can still strive for it. When the war is over, problems are going to be even greater than before. They will constitute a challenge to all of us and serve as great new frontiers, replacing the physical frontiers of the past. The younger generation has ahead of it the possibility of doing great things, but it will take lots of hard work and plenty of straight thinking. All of us can help in the same way.

Right now, as everyone knows, the most important thing before us night and day is to concentrate everything on winning the war at the earliest possible moment. After Pearl Harbor I had a plain little cardboard sign printed and put up near my desk. It reads: "Before You Do It—STOP!—THINK!—Will it Help Win the War?" It is going to stay there until the war is over and serve as a reminder to me and others who may see it—if any reminder is needed—that first things come first. Nearly everyone nowadays talks about rights of labor, rights of capital, rights of people, rights of individuals, right to be properly born, the right to a job, the right to have security in old age, the right to be free from want, free from fear, etc., but too few think or talk about their own obligations and responsibilities. For it is almost axiomatic that there can be no right without a corresponding responsibility. I think one of our greatest obligations or responsibilities is to think straight and honestly. Never make promises we can't keep. Don't say one thing just to be nice and do something else because it is to our selfish interest to do so. Respect the rights of others. Try to do what we can on a broad scale, but spend most of our time and devote our best efforts to our own individual jobs. If each person does whatever daily work he has to do better than it could be done by anyone else, nothing much will be wrong with the country. Let's all once more resolve to think straight, live straight, be mentally honest, respect the rights of others, prefer peaceful ways, but when we have to fight, fight with all our soul, intelligently, unrelentingly, until victory is won.

Army Division Award to Baltimore

(*Continued from page* 138)

its size in the Baltimore area. Also, that this was the first time the 29th Division Plaque had ever been given except to an individual.

Mr. Nicklas emphasized the need for continuing to support the blood donor project, noting that "good news from the European Theatre of operations has tended to dampen the enthusiasm of some blood donors." He was assured that the Gas and Electric Company employees would continue to support this worthy effort.

On Competitive Inequality and Public Power

Excerpt from Annual Report to the Stockholders of the California Oregon Power Company, Year Ended December 31, 1944

THE first rule of fair competition is that competitors play the game by the same set of rules.

The basic rule of taxation is that all taxpayers of like nature shall be taxed uniformly.

The nation's need for revenue to meet the tremendous cost of war and the constantly increasing expense of government dictates that no source of revenue be overlooked. Yet many lines of private business today are threatened with extinction and the nation is losing millions of dollars of desperately needed tax revenue because of tax exemptions and other special privileges and favors granted to rapidly growing groups of competitors.

Carry the process to its logical conclusion and where would the federal and local treasuries secure the revenues to maintain the legitimate functions of government? There is only one answer. It would have to tax remaining taxpayers more heavily or begin taxing the now provileged groups. If publicly owned power systems were taxed, the main argument now advanced to put private enterprise out of business would be ended.

Suppose the private electric company would ask for tax relief, agreeing to apply the entire savings to a reduction in its rates. What a cry would go up from every tax agency of government. And yet agencies of the government are at this very time sponsoring projects which, if carried out, will not only remove additional large amounts of tax producing properties from the tax rolls, but will permanently eliminate from the field of free enterprise large and important segments of the utility industry.

Why should the patrons of a publicly owned and operated power system be accorded any privileges not offered to all citizens? Why should any group of citizens be penalized by tax-evading communities and government projects which are maintained as business enterprises in competition with tax-paying industries which support government?

If tax exemption is not tax evasion it is certainly a reprehensible and indefensible form of public begging. I say begging because any community or agency asking for tax exemption actually asks the rest of the taxpayers of the nation to make greater contributions so that it can benefit from a special privilege. This is the kind of rank discrimination prohibited by law in private business.

We in the public utility business want no special privilege. All we ask is fair competition with all competitors abiding by the same set of rules and recognizing the same kind of yardstick. With such rules of fair play applied we would hold no fears for the future of private enterprise.

* * *

THE cause of public power, given a new impetus by the 1944 national election, is again on the march. Its advocates are active everywhere from the halls of Congress to the corner store in the rural communities. Their efforts are reflected in increased REA planning, growing pressure to establish PUDs, and a drive to create additional power authorities.

If the argument for building a tax exempt Federal power monopoly really is cheap electricity why wouldn't it be more logical to pass laws exempting the investor-owned electric industry from taxation? Such a program would promise rates below those offered by the various public power agencies—taxpayers would be relieved of the vast sums they are now being assessed to build competing government systems—and the power consumer would have the advantage of state regulation of the private plants and local management, something entirely lacking under the present scheme of government ownership and operation.

Electric power has been made such a political issue that many people have lost sight of the real principle involved. It isn't the argument most commonly used by administrators of tax-exempt federal projects that they can furnish power cheaper than can highly taxed private business. It is something far more fundamental than that. It is a drive to convert our free economy to some form of state socialism in which the iron hand of government bureaucracy would control all things.

If it is important for the government to go into the power business in order to save the householder a few cents a month on his electric bills, why should it not go the rest of the way and furnish food, clothes and rent at cost, which items make up the bulk of his financial worries?

The people should get the issue straight and then decide whether they want to change our country from a nation of private business to one of stateism. If we favor putting the government into the power business to save a dime, we should be a hundred times more anxious to put it into farm production, the clothing business and housing, not to mention the countless other activities upon which we are so dependent.

If we in America want to work for the government instead of for ourselves then we should vote for socialized industry. But don't be fooled into believing that half the business of a nation can operate without profit while the other half is allowed to make a profit, for notwithstanding the clear propaganda of patronage dispensers that government grants are gifts, every dollar distributed by government must first be taken from the people in taxes on their earnings and their business.

This nation's industry must be preserved as free institutions if we are to be saved from becoming mere pawns in a completely regimented system.

> "It's a matter of record that the performance of the electrical industry in America's war effort thus far is unsurpassed. This industry has been faced with colossal problems caused by the need for swift expansion of factories. Its response has been truly magnificent."—Brig. Gen. Donald Armstrong, Commandant, Army Industrial College.

1944 Electricity Production Measured Country's War Effort

The information which follows considerably amplifies and gives final figures on the data on the electric industry appearing in the January, 1945, issue of the EEI BULLETIN. *It is taken from the introductory section of EEI Statistical Bulletin No. 12, covering the Electric Light and Power Industry in the United States for the year 1944. In addition to the material presented here, Statistical Bulletin 12, which is just off the press, carries detailed statistical data on Generating Capacity, Generation, Fuel Used, Construction Expenditures, Sales and Revenue, Financial and other subjects.*

THE year 1944 justified all the predictions which the electric utility industry has consistently made as to its ability to supply the war load of the United States. Electric power has successfully met the peak of America's war effort and the year 1944, as a whole, has made one more all-time record in the production, sales and revenues of the electric utility industry. As in all previous years, no war program has been delayed by lack of electric generating capacity and, at the same time, full service has been maintained to all customers, military and civilian.

The use of industrial power has slowly declined from the high point reached in the fall of 1943, which marked the crest of the country's total production. With the continued success of the Normandy invasion and the rapid retreat of the Germans across France, the output of electric power in 1944 reflected the general slackening of munitions production. Following the failure of the British forces to break through in Holland and the beginning of sustained German resistance, this trend was reversed after reaching a low point during the week of Oct. 21. Since that time, power output has reflected the increased emphasis on the production of war materials and has paralleled the curve of a year ago.

It would appear that this trend may well be continued until the termination of the European war; the shut-down of the magnesium and aluminum plants, which are heavy users of electricity, offsetting the reopening of other factories making ammunition and armament, which are comparatively small customers of current.

For the first time in many years, the percentage increase in industrial power sales was less than in any other classification and this class of service comprised 62 per cent of total sales in 1944, substantially the same as the year before. On the other hand, retail sales of electricity have grown according to long-time trends. In particular, the use of electricity in the home has made the usual gain, in spite of the complete stoppage of the manufacture of household appliances and various limitations on the use of materials for the connection of new customers.

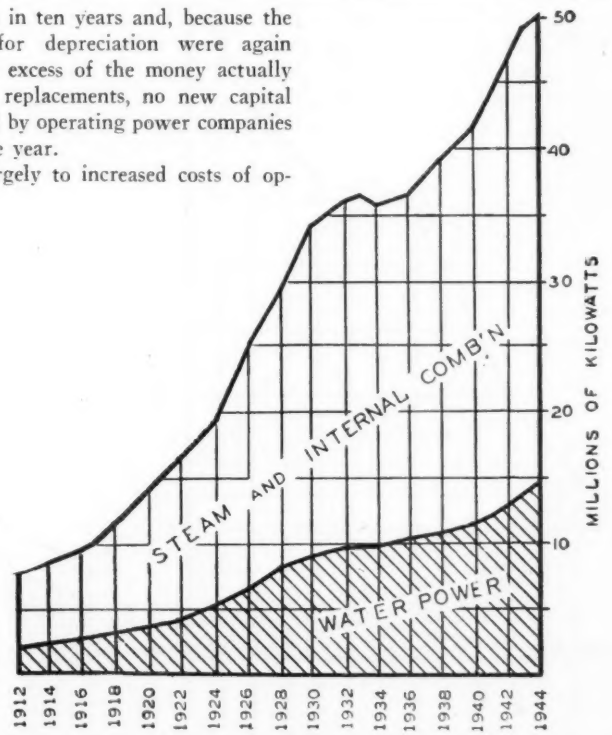
These restrictions on the use of materials were reflected in the lowest expenditures in ten years and, because the accruals for depreciation were again greatly in excess of the money actually spent for replacements, no new capital was raised by operating power companies during the year.

Due largely to increased costs of operation, the net income of the industry declined slightly from the previous year and approximated that of 1942, when business was about 25 per cent less.

Installed capacity of all electric utility plants, both governmental and company-owned, showed a net increase during the year of 973,000 kw, bringing the total at the end of 1944 to 50,277,577 kw. Since the beginning of the war in the summer of 1939, generating capacity has grown by 10,500,000 kw. Of this increase in installed capacity, some 7,000,000 kw has been in fuel-burning and 3,500,000 kw in hydro-electric plants.

As of the close of 1944, the distribution of generating capacity in kilowatts and its increase over the previous year is shown by the following table:

	Steam	Hydro	Internal Combustion	Total
December 31, 1944	34,609,172	14,604,344	1,064,061	50,277,577
December 31, 1943	34,178,253	14,066,970	1,059,330	49,304,553
Year's Increase	430,919	537,374	4,731	973,024



Installed Generating Capacity of All Electric Power Plants Contributing to the Public Supply

In spite of the large increase in governmental hydro-electric power in recent years, the installed capacity of water power plants still comprises only 29 per cent of the total generating capacity. In 1934 it was 27 per cent and in 1924 it was 26 per cent.

As in recent years, the bulk of the new steam-driven generators has been installed by utility companies, the bulk of the hydro-electric generators by the Federal Government.

As of the close of 1944 and 1943, the total generating capacity was distributed in kilowatts according to the ownership shown in the table below:

	Steam and Internal Combustion			Hydro-electric		
	Companies	Government	Govt. Is % of Total	Companies	Government	Govt. Is % of Total
December 31, 1944.....	31,446,663	4,226,570	11.8	8,764,595	5,839,749	40.0
December 31, 1943.....	31,041,192	4,196,391	11.9	8,830,421	5,236,549	37.2

On Dec. 31, 1944, companies had installed 40,211,258 kw in power stations of all types, or 80 per cent of total generating capacity, while the public plants totaled 10,066,319 kw or 20 per cent of the total.

Power Shortage Bogie Disappears

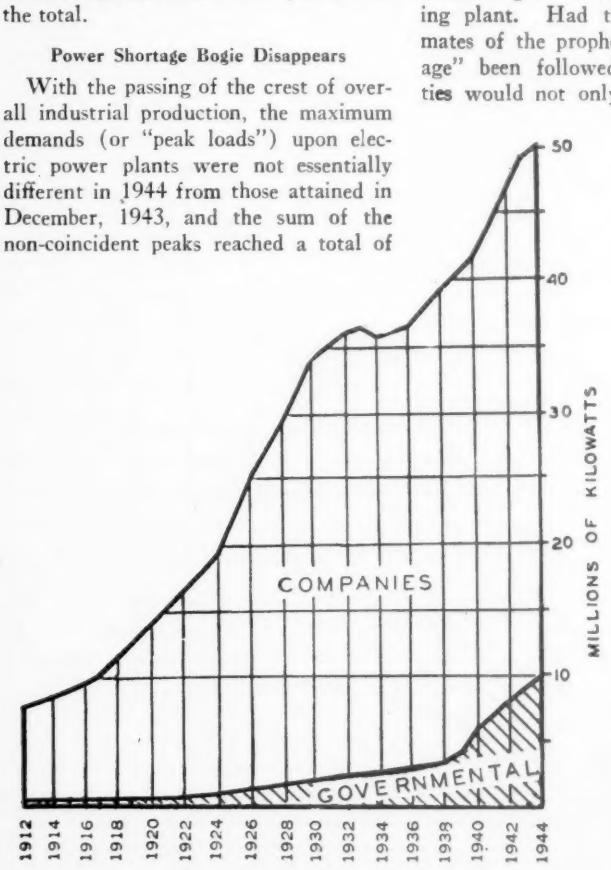
With the passing of the crest of overall industrial production, the maximum demands (or "peak loads") upon electric power plants were not essentially different in 1944 from those attained in December, 1943, and the sum of the non-coincident peaks reached a total of 41,500,000 kw as compared with 41,000,000 the previous year. The total installed capacity of 50,277,577 kw is thus 8,777,577 kw or 21 per cent above the maximum requirements and compared with a margin of 8,305,000 (or 20 per cent of peak demands) the year before. During the most active year of the country's history, and with industrial production near its peak, the margin of the utilities' reserves has thus actually increased by almost 500,000 kw. This represents, in its sufficiency, the fruit of years of careful planning on the part of the utilities, while, on the other hand, it completely refutes the many prophesies of "power shortage" which were advanced early in the war period.

It is much to the credit of the industry that it approaches the end of the war with no great overcapacity of generating plant. Had the extravagant estimates of the prophets of "power shortage" been followed, the electric utilities would not only have been saddled with a heavy burden of fixed charges, but the war itself would have been materially prolonged because of the diversion to the manufacture of unneeded power house equipment of the facilities which have built the magnificent Navy that is now dooming Japan.

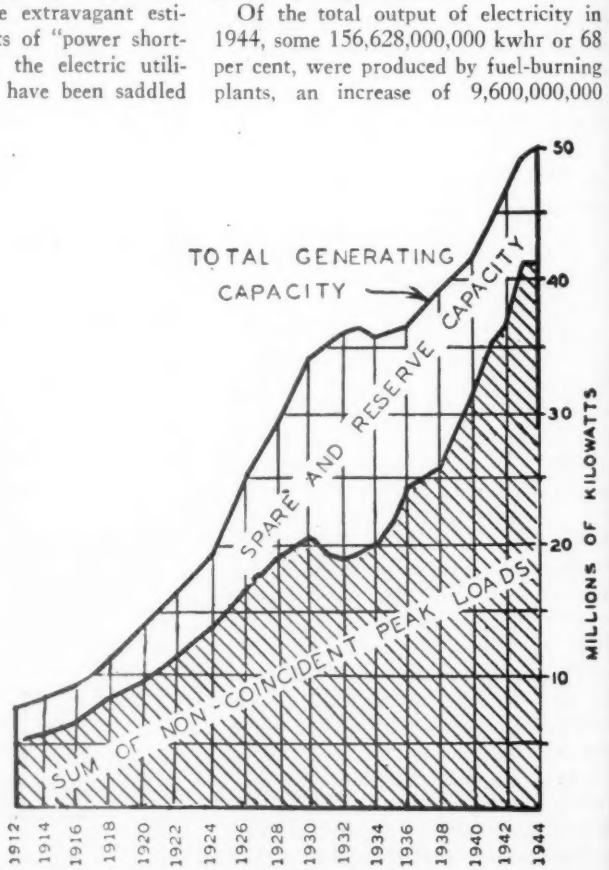
Output Exceeds 230,000,000,000 Kilowatthours

Output of electricity in 1944, by all agencies contributing to the public supply, totaled 230,649,000,000 kwhr, an increase of 9,680,000,000, or 4 per cent, over the production in 1943. All of this increase took place during the first eight months of the year, the remaining four having shown progressive declines. This net increase compares with a gain of some 32 billion kilowatthours, or 17 per cent, registered in 1943 over the year before. In the five years from September, 1939, when the Germans invaded Poland, to the present time, the total output has grown from 126 billion kilowatthours per year to the present total of 230 billion, or by 83 per cent, while generating capacity has grown by only 26 per cent.

Of the total output of electricity in 1944, some 156,628,000,000 kwhr or 68 per cent, were produced by fuel-burning plants, an increase of 9,600,000,000



Distribution of Total Installed Capacity Between Companies and the Various Agencies of the Government

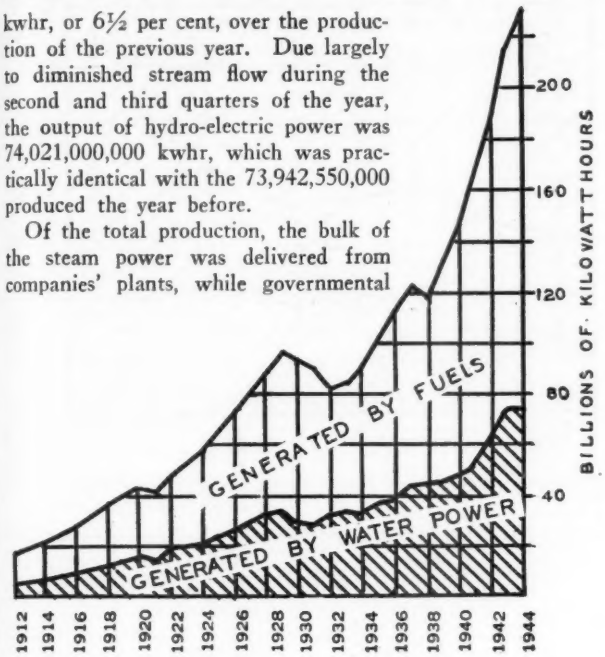


Comparison of Total Installed Capacity and Sum of Maximum Demand

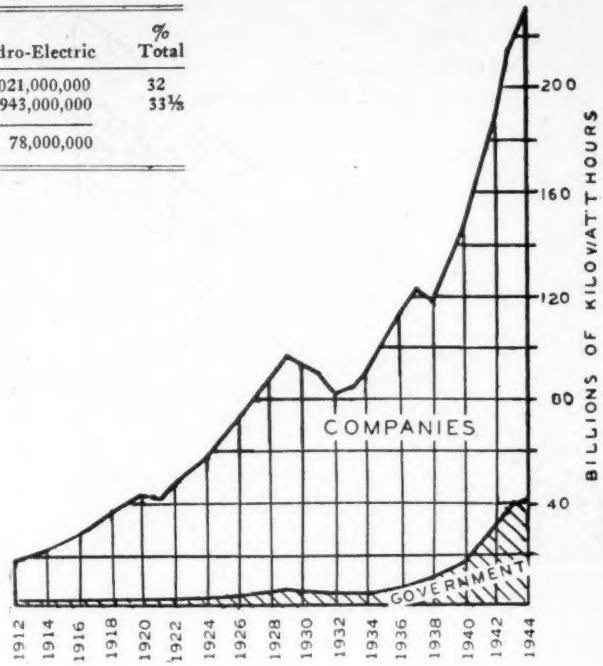
Year	Production Total	Steam and Internal Combustion	% Total	Hydro-Electric	% Total
1944	230,649,000,000	156,628,000,000	68	74,021,000,000	32
1943	220,970,000,000	147,027,000,000	66⅔	73,943,000,000	33⅓
Increase ..	9,679,000,000	9,601,000,000		78,000,000	

kwhr, or 6½ per cent, over the production of the previous year. Due largely to diminished stream flow during the second and third quarters of the year, the output of hydro-electric power was 74,021,000,000 kwhr, which was practically identical with the 73,942,550,000 produced the year before.

Of the total production, the bulk of the steam power was delivered from companies' plants, while governmental water power plants produced almost one-half of the total hydro-electric output.



Distribution Between Thermal and Hydro Electric Generation of Electricity by All Agencies Contributing to the Public Supply



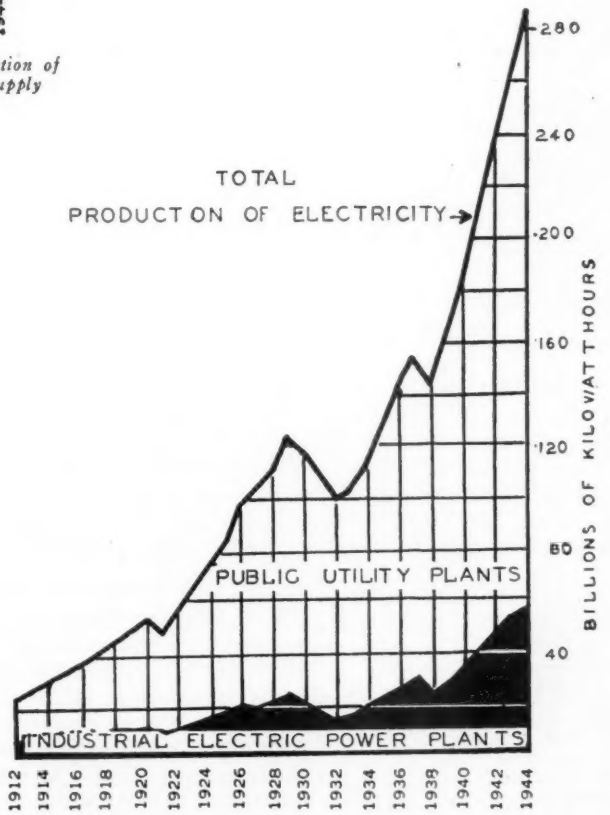
Distribution of Total Generation of Electricity Between Companies and the Various Agencies of the Government

During 1944, companies produced 187,464 million kilowatthours, or 81 per cent of the grand total, and governmental plants 43,185 million kilowatthours, or 19 per cent of the grand total.

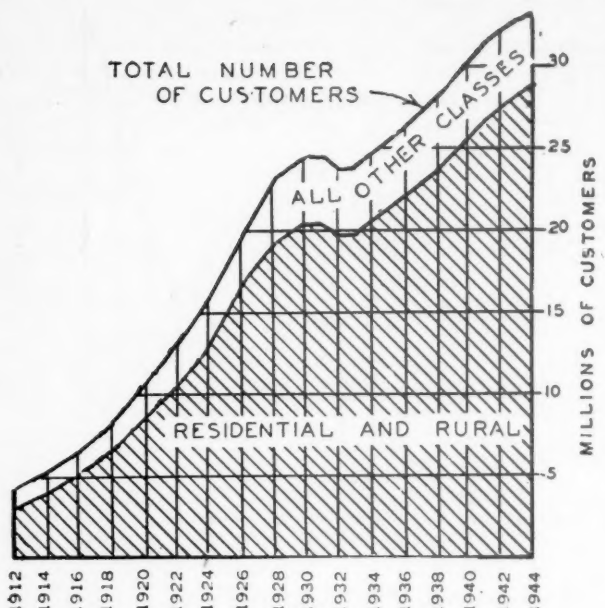
In addition to the production of electricity by public utility plants, approximately 50 billion kilowatthours were generated by industrial plants for their own use, bringing the total of all electricity generated for all purposes in the United States in 1944 to 280 billion. Besides this some 2½ billion more were imported from Canada.

The distribution of generation between companies and governmental plants was as follows (in millions of kilowatthours):

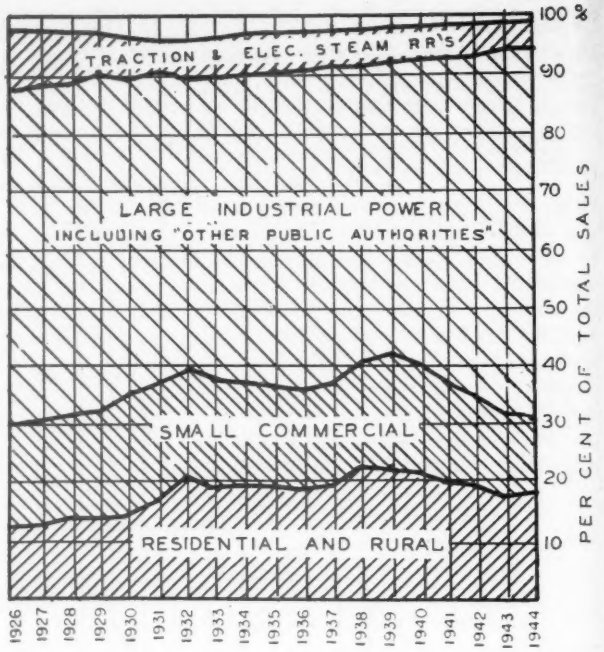
Year	Companies	Governmental	Govt. Is % of Total
	Steam and Internal Combustion		
1944	145,863	10,765	6.9
1943	136,390	10,637	7.2
	Hydro-electric		
1944	41,600	32,420	43.8
1943	45,436	28,507	38.6



Total Generation of Electricity in the United States, Including Industrial as Well as Public Utility Plants



Number of Electric Customers Served by All Agencies, Companies and Government



Proportion of Total Sales Taken by Various Classes of Customers

Number of Customers Still Increasing

During the year, more than 650,000 new customers were added to the books of the electric utilities, bringing the total at the end of the year to 33,048,392. The distribution of these customers on Dec. 31 is shown in the adjoining table.

Of the total number of 28,515,500 residential and rural customers on Dec. 31, 1944, it is estimated that 2,720,550 were farm customers. This represents an increase in farm customers of 193,050 during the year, out of a total increase of 554,163 in the residential and rural classifications.

At the close of 1944, 85 per cent of all customers were residential or farm customers.

Classification	1944	1943	% Change
Residential or Domestic	27,371,260	26,872,639	+1.9
Rural (Distinct Rural Rates)	1,144,241	1,088,698	+5.1
Commercial and Industrial			
Small Light and Power	4,263,395	4,168,245	+2.3
Large Light and Power	151,652	146,593	+3.4
Street and Highway Lighting	24,966	25,465	−1.9
Other Public Authorities	91,588	93,311	−1.8
Railways and Railroads	217	200	+8.5
Interdepartmental	1,073	1,149	−6.6
Total Ultimate Customers	33,048,392	32,396,300	+2.0

Sales of Electricity

The large expansion of electro-metals —aluminum, magnesium, electric steels and ferro-alloys—which constituted a striking feature of the increase in sales of electricity during the two previous years, slackened off in 1944. The curtailment of electric steels, the shutdown of the aluminum plants operating on fuel-generated power and the stoppage of the manufacture of magnesium contributed largely to the decline in power sales during the last four months of the year. On the other hand, the use of power for general manufacture continued at approximately last year's levels. The distribution of sales is shown below.

Because of the continued increase in sales of industrial power (including sales to "other public authorities") this class of service increased to 62 per cent of the total business of the utility companies. If the estimated output of 50 billion kilowatthours produced by industrial plants generating electricity for their own purposes is added, the total of 173 billion kilowatthours of industrial power constitutes 70 per cent of the entire electrical consumption of the country. The importance of industrial electricity in what might be termed the electrical economy of the United States is emphasized by the charts.

The relative proportion of kilowatthour sales by various classes of use is indicated on the chart above and in a table on the next page.

Industrial power production parallels the industrial output of the United States, and any correct estimate of postwar events should be based upon the prolongation of the curves shown on the chart above, which, in turn, require an intelligent and unbiased interpretation of events since 1926.

Kilowatthour Sales	1944	1943	% Change
Residential or Domestic	31,266,439,000	28,621,403,000	+ 9.2
Rural (Distinct Rural Rates)	3,372,943,000	2,996,098,000	+12.6
Commercial and Industrial			
Small Light and Power	29,837,317,000	28,192,012,000	+ 5.8
Large Light and Power	115,187,287,000	106,657,286,000	+ 8.0
Street and Highway Lighting	2,162,655,000	2,075,048,000	+ 4.2
Other Public Authorities	8,462,816,000	9,139,328,000	− 7.4
Railways and Railroads	7,328,439,000	7,225,457,000	+ 1.4
Interdepartmental	542,715,000	982,629,000	−44.8
Total Kilowatthour Sales	198,160,611,000	185,889,261,000	+ 6.6

For recent years, the trends of industrial production and industrial electric power are shown by the following table, in which the production of isolated industrial plants is added to the sales of power by utilities.

Year	FRB Index Industrial Production (1935-39 = 100)	Kwhr of Industrial Power
1929	110	68 billions
1932	58	48
1937	113	85
1938	89	72
1939	109	86.5
1940	125	99.5
1941	162	121.5
1942	199	140
1943	239	167.5
1944	235	173

War Work in the Utilities' Total

According to advices received from the Federal Reserve Board, the proportions of total industrial production devoted to the manufacture of war materials in the United States have been as follows:

Year	Index of Industrial Production (Per Cent of 1935-39 Average) War	Civilian	Total	War Is % Total Prodn.
1939	2	107	109	2
1940	6	119	125	5
1941	32	130	162	20
1942	107	92	199	54
1943	159	80	239	67
1944	157	78	235	67

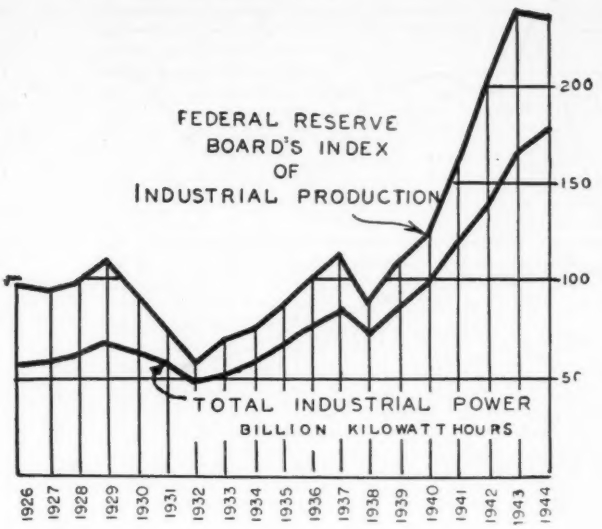
Application of these percentages to the sales of industrial power (i.e., "large light and power" plus "sales to other public authorities") shows that total sales of electricity for civilian uses have approximated prewar levels throughout the war period.

ELECTRICITY IN PEACE AND WAR

Kilowatthours Sold by the Electric Light & Power Industry

Year	*Industrial Power* War	*Civilian Uses* Civil	All Other Classes	Total Civil	Grand Total Sales
	billion kwhr				
1939	.1	53	52	105	106
1940	.3	59	57	116	119
1941	.15	64	61	125	140
1942	.50	42	67	109	159
1943	.77	39	70	109	186
1944	.83	41	74	115	198

A comparison of this estimate of sales of industrial power for military and naval purposes with the total money expended by the Federal Government for war bears out the predictions made at the very start of the war by the Electric Light and Power Industry that for every dollar of war expenditures there would be sold for war purposes one kilowatthour of electricity.



Sales of Industrial Power Measure Industrial Production

PER CENT OF TOTAL KILOWATTHOURS SOLD

Year	Residential	Rural	Small Commercial	Large Industrial	Other Public Authorities*	Railways and Railroads	Other
1944	15.8	1.7	15.1	58.1	4.3	3.7	1.3
1943	15.4	1.6	15.6	56.9	4.9	3.9	1.7
1942	16.9	1.8	17.1	55.4	2.6	4.2	2.0
1941	17.9	1.7	17.6	54.3	2.2	4.4	1.9
1940	19.7	1.7	18.8	50.2	2.3	5.0	2.3
1939	19.9	1.8	19.6	48.3	2.4	5.5	2.5
1929	13.0	1.8	17.4	57.1	0.5	7.5	2.7

* "Other Public Authorities" include army camps, air fields, etc., and industrial plants financed by funds from the Reconstruction Finance Corporation in aid of National Defense.

Year	U. S. Expenditures for War (Million $)	Kwhr Sold for War Total (Millions)	Kwhr per $
1940	1,911	3	1.55
1941	13,895	15	1.08
1942	52,406	50	0.95
1943	85,135	77	0.90
1944	91,150	83	0.91

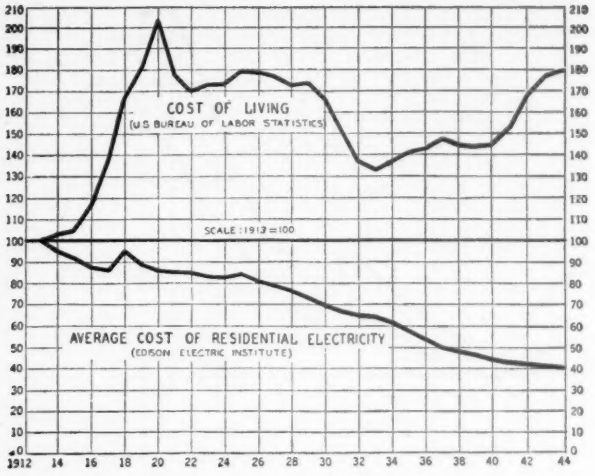
Residential Service

In spite of the impossibility of procuring new appliances, the use of electricity in the home in 1944 increased over 1943 by 2½ billion kilowatthours, or 9 per cent, to an estimated total of 31,266,439,000. This increase was caused partly by the establishment of what practically amounted to two homes by families with war workers on two or three shift operation. More particularly it can be explained by the greater use of current arising from the keener appreciation by customers of the value of the service that electrical equipment can give and the consequent restoration to active use of many thousands of hitherto idle appliances. The annual use of current by the average residential customer totaled 1151 kwhr at the end of 1944, as compared with 1070 the year before—an increase of 81 or 7½ per cent, over 1943.

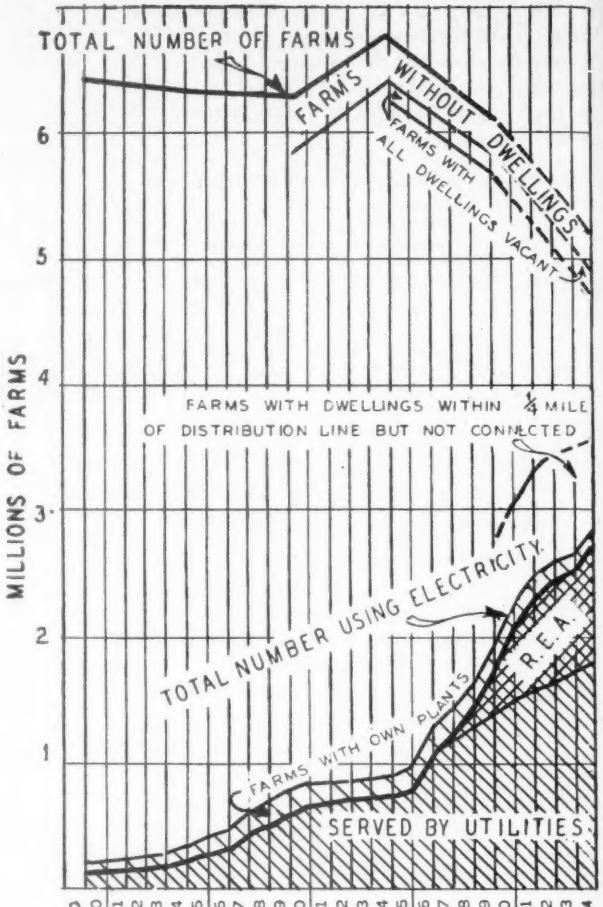
In sharp contrast to rising operating expenses and taxes the average cost to the customer of residential electric service continued its usual decline and is now 3½ cents per kilowatthour—an all-time low.

The trend of residential sales during recent years is shown by the following table and the long-term trend is illustrated by the following chart.

Year	Kwhr per Customer	Cents per Kwhr	Average Annual Bill
1944	1,151	3.51	$40.00
1943	1,070	3.60	38.52
1942	1,022	3.67	37.51
1941	986	3.73	36.78
1940	952	3.84	36.56
1939	897	4.00	35.88


COST OF LIVING
(U.S. BUREAU OF LABOR STATISTICS)
SCALE: 1913 = 100
AVERAGE COST OF RESIDENTIAL ELECTRICITY
(EDISON ELECTRIC INSTITUTE)

Residential Electricity and Cost of Living Compared with the Year 1913


TOTAL NUMBER OF FARMS
FARMS WITHOUT DWELLINGS
FARMS WITH ALL DWELLINGS VACANT
FARMS WITH DWELLINGS WITHIN ¼ MILE OF DISTRIBUTION LINE BUT NOT CONNECTED
TOTAL NUMBER USING ELECTRICITY
R.E.A.
FARMS WITH OWN PLANTS
SERVED BY UTILITIES
MILLIONS OF FARMS

Development of Rural Electrification in the United States

Cost of Living Up 24 Per Cent But Electricity Costs Less

At the close of 1944, the cost of living, as shown by the index numbers published by the U. S. Bureau of Labor Statistics, was 127 per cent of the 1935-39 average. At the same time, the index numbers of the monthly bills shown by the Federal Power Commission for 25 kwhr per month stood at 90 per cent of the 1935-39 average, while the index for 100 kwhr per month was 91 per cent, and for 250 kwhr per month, 89 per cent. In other words, while the cost of living was going up by 24 per cent, the small man's use of electricity for lighting declined by 10 per cent; for lighting, small appliances and refrigeration by 9 per cent; and for use with cooking, by 11 per cent. The figures for recent years are shown by the following table:

Year (Dec. 31)	U.S.B.L.S. Cost of Living	FEDERAL POWER COMMISSION Average Bill per Month 25 Kwhr	100 Kwhr	250 Kwhr
	—Per Cent of 1935-39 Averages—			
1944	127.0	Not Yet Available		
1943	123.5			
1942	116.5	90	91	89
1941	105.0	90	92	89
1940	100.1	91	92	90
1939	99.4	91	92	90

Farm Service

During 1944 the extension of utility lines in rural areas continued. The net gain in farm customers was 193,050, bringing the total at the end of 1944 to 2,720,550, and comparing with a figure of 2,527,500 the year before. The previous year's net increase was 67,500.

There has been a large and growing evacuation of farms during the past five years. In January, 1944, there were only 25,521,000 persons living on farms, according to the estimates of the Bureau of Agricultural Economics of the U. S. Department of Agriculture. From a level of 30,216,000 on April 1, 1940, the farm population has decreased in four years by almost 5,000,000 persons, or 16 per cent. The *number of farms* has also decreased in almost the same proportion and, with this, the potential market for rural electrification. At the present time, the total number of farms is approximately 5,200,000, of which 2,720,550, or 52 per cent, are customers taking electricity from public utility lines.

FARM ELECTRIFICATION IN THE UNITED STATES
(All Agencies, Companies and REA)

Year	Estimated Farm Population	Estimated Number of Farms	Electric Customers	Customers Are % of Farms
Dec. 31, 1944	25,000,000	5,200,000	2,720,550	52.3
1943	25,521,000	.....	2,527,500	...
1942	26,659,000	.....	2,460,000	...
1941	29,048,000	.....	2,330,000	...
1940	29,988,000	.....	2,050,000	...
Apr. 1, 1940	30,216,188	6,096,799	1,853,249	30.4

Revenues

Revenues of the electric utilities showed almost the same percentage gains as did kilowatthours and registered the largest total in the history of the industry. The adjoining table shows distribution of these revenues.

Revenues from Customers*	1944	1943	% Change
Residential or Domestic	$1,097,725,500	$1,029,259,700	+ 6.6
Rural (Distinct Rural Rates)	82,842,300	76,617,200	+ 8.1
Commercial and Industrial			
Small Light and Power	817,355,400	773,677,600	+ 5.6
Large Light and Power	1,043,391,800	964,191,600	+ 8.2
Street and Highway Lighting	76,626,100	75,383,900	+ 1.6
Other Public Authorities	94,452,300	94,957,600	— 0.5
Railways and Railroads	60,273,400	58,098,700	+ 3.7
Interdepartmental	4,084,600	5,456,600	—25.1
Total Revenues	$3,276,751,400	$3,077,642,900	+ 6.5

* Net figures, after all rebates, "customer refunds," etc.

Because retail sales carry higher unit prices than do wholesale transactions, the proportion of total *revenues* received from each class of service is different from the proportion of kilowatthours. For recent years, this is shown in the adjoining table.

PER CENT OF TOTAL REVENUES

Year	Residential	Rural	Small Commercial	Large Industrial	Other Public Authorities	Railways and Railroads	Other
1944	33.5	2.5	24.9	31.8	2.9	1.8	2.6
1943	33.4	2.5	25.2	31.3	3.1	1.9	2.6
1942	34.7	2.6	26.9	29.0	2.1	1.9	2.8
1941	35.2	2.4	27.2	28.5	1.8	1.8	3.1
1940	36.7	2.0	28.2	25.9	1.9	2.0	3.3
1939	36.8	2.0	28.9	25.0	1.8	2.0	3.5
1929	31.9	1.1	28.7	30.5	0.5	2.7	4.6

INCOME STATEMENT—ELECTRIC LIGHT AND POWER COMPANIES

	1944 (Milions of Dollars)	1943	% Change
Revenues from Customers*	2,876	2,744	+ 4.8
Sales to Co-ops. and Municipals	29	26	+11.5
Other Electric Revenues	50	46	+ 8.7
Gross Revenues	2,955	2,816	+ 4.9
Operating Expenses	1,225	1,127	+ 8.7
Depreciation	309	307	+ 0.7
Taxes	703	680	+ 3.4
Revenue Deductions	2,237	2,114	+ 5.8
Operating Income, Electric	718	702	+ 2.3
Income, Other Departments	60	66	— 9.1
Non-operating Income	65	66	— 1.5
Gross Corporate Income	843	834	+ 1.1
Interest and Other Deductions	334	322	+ 3.7
Net Income	509	512	— 0.6
Dividends, Preferred	119	127	— 6.3
Common	279	292	— 4.5
Total Dividends	398	419	— 5.0
Balance to Surplus	111	93	+19.4

* Net figures, after rebates, "customer refunds," etc.

The Income Statement—Companies

Increased Revenues Offset by Increased Expenses

Total revenues (excluding inter-company sales) of the electric utility companies were $2,955,000,000 in 1944, an increase of $139,000,000, or 5 per cent, over the receipts of the previous year. Much of this gain, however, was offset by increased operating expenses, which were $98,000,000, or 9 per cent, greater in 1944 than they were in 1943.

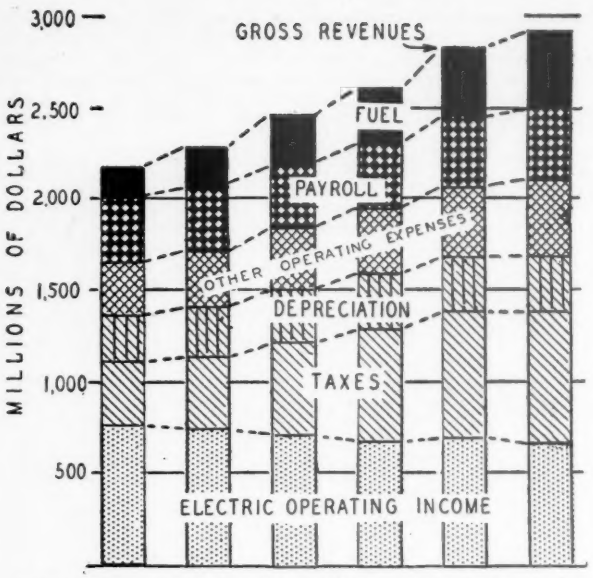
The cost of fuel alone is estimated to have grown from $363,000,000 in 1943 to over $400,000,000 in 1944 and this compares with $203,000,000 in 1940. In four years, the utility companies' fuel bill has thus doubled.

Taxation at Its Peak

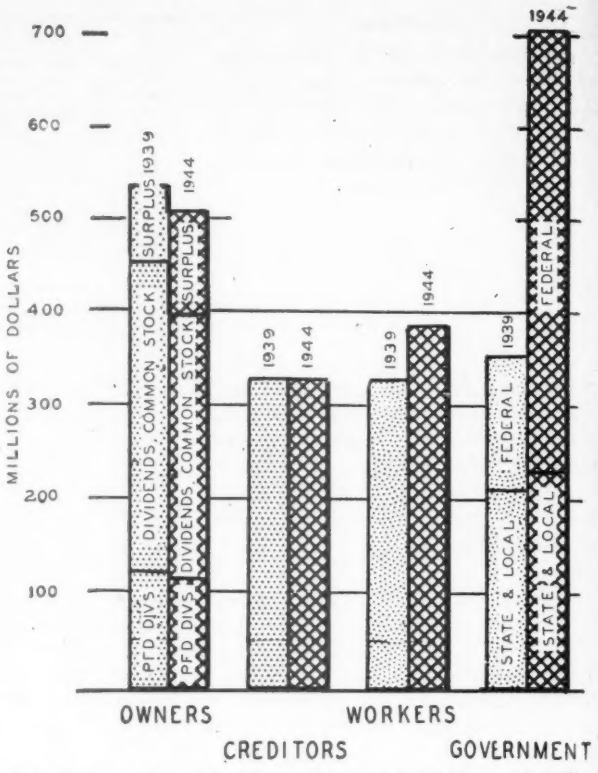
The total of all taxes—Federal, State and Local—is estimated at $703,000,000 for the year 1944. This figure allows for reductions in the Federal Excess Profits Tax for several companies making rebates to their customers for the purpose of avoiding this particular tax. It also reflects savings in taxation by companies through refinancing and taking advantage of extraordinary deductions. The total of $703,000,000 represents an increase of $23,000,000 or 3½ per cent, over the $680,000,000, paid in 1943. Of these taxes, $468,000,000, or two-thirds, were paid to the Federal Government. Taxes now represent 24 per cent of all the money received by the electric utility companies from their customers. The distribution of taxes during the past two years is indicated by the following table:

	1944 Total Tax (Million $)	1944 % Revenues	1943 Total Tax (Million $)	1943 % Revenues
Federal Taxes				
3% Excise	55	1.86	49	1.74
Miscellaneous Federal	12	0.41	15	0.53
Income and Surtax	191	6.47	196	6.97
Excess Profits	210	7.10	188	6.66
Total Federal	468	15.84	448	15.90
State and Local	235	7.95	232	8.25
All Taxes	703	23.79	680	24.15

On the next page a chart shows the change in the character of the electric light and power business since the outbreak of the European war in 1939. The share of the owners, represented by dividends and surplus, has declined by $30,000,000, or 5½ per cent. The share of



Income Statement of the Electric Light and Power Companies—While Gross Revenue Goes Up, Operating Income Comes Down



Five Years' Changes in the Earnings of Participants of Utility Companies' Operations

the creditors, represented by interest, amortization and other deductions, remains unchanged. The share of the worker, represented by salaries and wages, has risen from $340,000,000 to $388,000,000, or by 15 per cent. The share of Government, represented by taxes, has risen from $352,000,000 in 1939 to $703,000,000 in 1944. This is an increase of $351,000,000, or 100 per cent.

Summary

The record of America's prodigious industrial accomplishment to overthrow the great military powers that were near to conquering the Eastern hemisphere and winning the biggest war in history is accurately measured in the tables and charts of the EEI Statistical Bulletin 12 of the Electric Light and Power Industry from which the foregoing material is taken.

Generation of electricity serves as a precision meter for industrial production because electric power has become the driving force of practically all American industry. And during the war the electric power industry reached world peaks in kilowatthours, capacity to produce electricity, customers, revenues, taxes—and all this with a comparatively small increase in new generating plants and with an actual drop in workers, rates and replacement materials. While other costs of living climbed, rates for electricity went down.

At the start of the war there was a cry that the electric light and power industry could not supply all the current needed to fight a global conflict. Yet power was provided to make turret guns and electric compasses, bean soup and GI socks, without cutting off any power for civilian use.

The farmer continued to milk his cows by electricity, city lights burned and elevators ran while the United States made freighters, tanks, planes and bazookas in such number as to amaze both our Allies and our enemies. There was current for electric toasters while new factories covering acres devoured power coming from as far as ten states away—coming through replacement of energy requirements over the nation's interconnected systems.

Specifically while meeting the increasing demands for "Power for Victory" during the past year, the Electric Light and Power Industry of the United States has:

(1) Fully met all the electrical requirements of the Nation.

(2) Produced more electricity and served more customers than ever before.

(3) Delivered more electricity to the mines and mills of the Nation than ever before and thus helped these plants to increase their production of the materials of war.

(4) Cooperated closely with the Armed Forces, by making available, when needed, equipment and trained manpower. This has made it possible for the Forces to build, operate and maintain electric services for the military camps and training fields of the Nation.

(5) Participated extensively in adapting their operations to the overall needs of the war and assisted in organizing civilian life for the war emergency. This has included:

(a) Pooling of equipment and materials.

(b) Conservation of fuels, rubber and manpower.

(c) Special training of army and navy personnel.

(6) Added more power-producing equipment, with the aim of being fully prepared in advance for a still greater war effort and for all postwar demands.

(7) Sold its services, in a year of rising prices, at lower average rates than ever before.

(8) Demonstrated once more, in a year of vanishing servants and services, the value of electric service and of household electric appliances.

The Proposed Missouri Valley Authority—A Threat to National Flood Control

By Hon. Will M. Whittington

Representative in Congress from the State of Mississippi

Summary of a Statement Made April 23, 1945, Before the Commerce Committee of the U. S. Senate in Opposition to S. 555, the Missouri Valley Authority Act, Known as the Murray Bill, and the Substitute Proposed by the Department of the Interior

THE proposed Missouri Valley Authority and similar authorities threaten national flood control. As a Representative of the Lower Mississippi Valley, and as an advocate of national flood control, I oppose the proposed Missouri Valley Authority and other similar authorities as they could be so operated as to prevent adequate flood control in the Lower Mississippi Valley and would thus threaten, if not wreck, the policy of national flood control adopted by Congress about 11 years ago. I further oppose the authorities as unsound in theory and in practice.

For some 125 years river and harbor improvements have been constructed by the Corps of Engineers. The first flood control improvements were authorized in 1917 and were confined to only two navigable rivers—the Lower Mississippi and the Sacramento. The improvements were really incidental to navigation. Following the great flood of 1927 the control of floods in the Lower Mississippi Valley was declared to be a national problem. The Act of 1928 again authorized flood control improvements along the Mississippi and Sacramento Rivers by the Corps of Engineers. Probably the most important and significant work in connection with the improvements of the rivers of the country was undertaken under House Document 308 of the 69th Congress. Examinations and surveys by the Corps of Engineers were authorized on the principal rivers of the United States. Under the 308 reports, all examinations cover the water problems of the river investigated. The Engineers were directed to report on navigation, flood control, irrigation, and power.

There is nothing new in the proposal involved in authority bills. Some 15 years ago under the Administration of President Herbert Hoover, himself a great engineer, a Department of Public Works, to assume jurisdiction over all public improvements, was proposed. The Corps of Engineers, and for that matter, the Bureau of Reclamation would have been scrapped. The Corps of Engineers would have been deprived of their civil functions. I was a member of the committee in the House that considered the proposal. After thorough hearings and exhaustive discussion, the proposal was rejected and so definitely buried that there has been no attempt at resurrection.

Congress not only rejected the proposal to strip the Engineers and the other established agencies of their functions, but in 1936 first adopted a policy of national flood control applicable to all the rivers of the country. The Act of 1936 vested in the Corps of Engineers the construction of improvements to control floods, including levees and flood walls to keep the waters out, diversions and spillways to supplement the main streams, and reservoirs to detain the waters at their source. There was vested properly under the act in the Department of Agriculture, the soil conservation, retardation, and reforestation involved. There has been coordination. There has been no conflict. Unparalleled progress has been made. Projects have been constructed in all the river basins in the United States. But progress has its opposition, and with successive and maximum floods, renewed efforts have been made to scrap the activities of the Corps of Engineers in flood control, and the Bureau of Reclamation in irrigation. Attempts have been made following major floods to supersede and supplant the adopted policy and the adopted program.

In 1933 the Tennessee Valley Authority Act, the first and only authority act ever passed by Congress, was adopted. That authority is primarily for the development of power. Efforts to develop and improve the natural resources of the Tennessee River, where there were greater power possibilities than along any other river east of the Rocky Mountains, had been thwarted by the short-sighted policy of the private power interests.

It has been stated that the Tennessee Valley Authority has provided flood control for that valley. It is significant that the act was not based upon flood control in the Tennessee River. I quote from the act, "to control the destructive flood waters in the Tennessee River and the Mississippi River Basins." I mention this fact to emphasize that in the pending Missouri River Valley Authority Act it is proposed to control the floods of the Missouri River alone. The proposal was not confined to the Tennessee River in the Tennessee Valley Authority Act. If it had been, the proposal would have been unsound. That authority is not only primarily for the development of power, but it is an experiment, and that experiment, while I favored the authority, is still in an experimental stage. Whatever may be said in behalf of the Tennessee Valley Authority Act, it is admitted that it has not protected the valley of the Tennessee River from floods. Instead of protecting that valley, the construction of the dams from the mouth of the Tennessee to its source has converted the entire valley into reservoirs. Before the authority was authorized it is estimated that the greatest area that could have been overflowed was 420 thousand acres. Now 360 thousand acres, or 6/7 of the entire area, are under water in the reservoir bottoms of the Tennessee Valley. Other careful estimates are that all of the lands that were ever overflowed in that valley are now condemned as bottoms for the reservoirs.

Following the great flood of 1937 in the Ohio Valley, the praises of the Tennessee Valley Authority Act were sung

as a measure to protect the Ohio Valley from floods. There had been a flood in 1927 in the Tennessee Valley. What are the facts with respect to the flood in the Ohio Valley in 1937 as compared to the flood in 1927? That flood exceeded all previous gauges by some 10 feet along the Ohio at Cincinnati and Louisville. The river gauges tell the story of floods along the Tennessee River. At Knoxville in 1927 the gauge was 19 feet. There was no dam or reservoir above Knoxville. In 1937 the gauge was 19 feet. At Chattanooga in 1927 the gauge was 33 feet. In 1937 it was 32.9 feet. The Norris Dam is above Chattanooga. At Johnsonville, some 90 miles from where the Tennessee empties into the Ohio at Paducah, in both 1927 and 1937 the gauge was 41 feet. Comparisons are often odious. This is especially true when they are not apt or correct.

There is at least one important flood problem along the Tennessee River. It involves the City of Chattanooga. The Corps of Engineers were called upon to solve the problem. It is significant that, notwithstanding the Tennessee Valley Authority, flood control at Chattanooga has been entrusted to the Corps of Engineers. In the Act of 1941 there is included a project authorizing the expenditure of $13,500,000 by the Corps of Engineers for the protection of the Chattanooga area. There is much loose talk about cooperation and about the lack of coordination. The fact is that in the only authority thus far adopted by Congress, the Corps of Engineers, by act of Congress some eight years after the authority was authorized, were directed to provide for flood control in that valley. The contention of those who urge an overall authority for correlation and cooperation is thus exploded by the adopted program respecting the only authority thus far authorized.

I supported the Tennessee Valley Authority. It was authorized to provide primarily for the development of power and for a yardstick as to the value of water power development. I accord to the authority all the credit that it deserves in the reduction of power rates. But Congress has passed other legislation that has materially contributed to the reduction of power rates. The Public Utility Act and the Securities and Exchange Act have played a part in the reduction and adjustment of power rates. But I repeat that the Tennessee Valley yardstick has been most helpful.

In considering the Missouri Valley Authority and in urging the Tennessee Valley Authority as a precedent, especially with respect to flood control, it is well to keep in mind that the Tennessee Valley Authority itself concedes that the improvements of that authority, instead of providing for protection to the lands of the Tennessee Valley, have converted those lands to perpetual overflow as the bottoms of reservoirs. The authority bases its contention that the flood control resulting benefits the Lower Mississippi River on the claim that flood heights have been reduced from Cairo south.

If properly operated as provided by the Flood Control Act of 1944, the Tennessee dams, including the Kentucky Dam, can obtain a maximum effect at Cairo of about two feet. To obtain that result, the major flow will have to be coming from the Tennessee Basin in synchronism with the crest at Cairo.

Congress rejected the authority act following the Ohio flood in 1937 after careful and exhaustive investigations and adopted the Flood Control Act of 1937, for improvements along the Ohio River to control floods under the supervision of the Corps of Engineers, and followed the act of 1937 by adopting the Comprehensive Flood Control Act of 1938 to provide for flood control projects in the Ohio and the other principal valleys of the United States.

But the advocates of authorities and of lump sum appropriations were not idle. The Mississippi Valley Committee was set up under the Public Works Administration by Secretary Harold L. Ickes, Administrator during the depression. It submitted a report on October, 1934. This committee was not authorized by congress, but the National Resources Board was established under the Executive Order of President Franklin D. Roosevelt, and this board and the National Resources Committee submitted reports after large expenditures with various proposals, and was in turn succeeded by the National Resources Planning Board without legislative authority. This board was finally abolished by Congress failing to make appropriations for the successor of the previous committees and boards known as the National Resources Planning Board that was never approved by Congress. The Secretary of the Interior was administrator of the public works during the emergency, for which lump sum appropriations were made. It is believed that the planning efforts contemplated authorities and the scrapping of the civil functions of the Corps of Engineers.

In the Reorganization Act of 1939 Congress provided that the functions of the Corps of Engineers should not be transferred to any other agency, but should remain as provided by existing law in the War Department. Like the General Accounting Office, I have regarded the Corps of Engineers as the arm of Congress to investigate impartially all improvements along our rivers and harbors that Congress is called upon to make. Congress has been zealous to preserve and protect the functions of the Corps of Engineers. The Flood Control Act of 1938 was followed by the enlargement and extension of the improvements authorized in the Flood Control Act of 1941.

THE MISSOURI VALLEY

There were excessive floods along the Missouri River in 1943 and 1944. The praises of the Tennessee Valley Authority were again sung. The advocates of spending and of lump sum appropriations and the sponsors of economic and social improvement again urged an authority for the Missouri River. The precedent of the Tennessee Valley Authority was again invoked. The Committee on Flood Control and the Committee on Commerce conducted extensive hearings. No two rivers have identical problems, but the fundamental problems in the alluvial portions of all rivers are substantially the same.

Reclamation and flood protection are the great objectives along the Missouri River. Power and navigation are relatively less important. The Missouri River is different from the Tennessee River. It is long. The Tennessee is short. The Missouri River has a flat profile. The Tennessee has a steep profile. The silt problems and the shifting nature of the Missouri are entirely different from the Tennessee River. There is no irrigation in the Tennessee Valley. Irrigation is essential in the Upper Missouri Valley. There is ample rainfall along the Tennessee River. Again in the Tennessee Valley there are no established water rights. The case is different in arid and semi-arid states. There water is the life blood of the country. Water rights are among the most valuable of properties.

The authority idea was thoroughly explored. There was rivalry between the Corps of Engineers and the Bureau of Reclamation. There was a question of supervision. The Bureau of Recla-

mation had no solution of the real flood problem which extended from Sioux City to the mouth of the Missouri River. But rivalry and competition are often helpful. The differences did not involve construction but supervision and finally, as the Secretary of the Interior, Honorable Harold L. Ickes observes, the differences were composed. Cooperation between flood control and reclamation was announced. Coordination was provided. The problem from Sioux City to the mouth is primarily a levee problem. The problem in the upper stretches of the river and along the tributaries involves not only flood control, but primarily reclamation. The position of those who advocated an authority in the Missouri River Valley was held to be untenable. Flood control would have been wrecked. Irrigation would have been in danger. Again the authority idea was rejected. The Flood Control Act of December 22, 1944, was adopted. Projects under the supervision of the Bureau of Reclamation were authorized at an estimated cost of 2 hundred million dollars. Projects to promote flood control and navigation by the Corps of Engineers were authorized at an estimated cost of 2 hundred million dollars.

The act provided that authorities might be subsequently considered by Congress. Such a provision was wholly unnecessary. Congress has the right to amend and to modify or repeal with or without such a provision in any act passed.

Flood control work generally has been discontinued for the duration. Improvements will be resumed following the cessation of hostilities.

The proposed Missouri Valley Authority and some 7 to 9 similar proposals would wreck the adopted policy and would destroy the provisions made by Congress for the improvement not only of the Missouri River, but of other rivers in the principal basins of the United States. The projects would be wrecked before construction is begun.

Previous flood control acts provided primarily for flood control and for power and navigation wherever practicable. The War Department and the Department of Agriculture cooperated and coordinated. This cooperation has been successful. No super-authority to control the established agencies has been necessary.

For the first time, in the Act of 1944, after a thorough study over a period of years, Congress adopted projects for soil conservation and reforestation recommended by the Department of Agriculture. But the Act of 1944 went a step further. It provided for reclamation projects in the Missouri River Basin and the differences between the reclamation projects and the flood control projects were reconciled. Cooperation was provided. If there can be cooperation between the Department of Agriculture in soil conservation and reforestation, surely there can be cooperation between the Corps of Engineers and the Bureau of Reclamation.

While the Tennessee Valley Authority is invoked as a precedent for economic and social improvements along the entire valley, the fact remains that reforestation and soil conservation in the area of that valley are in cooperation with the Department of Agriculture. As I understand, the Tennessee Valley Authority, out of lump appropriations, supplements the appropriations of the states and of the United States. I believe in equality of treatment. I think the citizens of the Tennessee Valley are entitled to the same treatment in reforestation and soil conservation as the citizens of any other valley or any other part of the United States. They are entitled to no more. Neither are the citizens of the Missouri Valley entitled to any more.

If an authority is necessary to coordinate all improvements in the Missouri or in any other valley, we might as well abolish the Soil Conservation Service and the Forestry Service. There is no occasion for duplications. There is no occasion for preferential treatment.

WHY AUTHORITIES ARE OPPOSED

I oppose the authority or regional plan. There are many reasons for my opposition. I mention but a few:

1. Authorities are advocated by the spenders and by those advocating projects unable to stand on their own merits. They are advocated by the planners and by the planning agencies. They are advocated by those who believe in reforming and remaking America. They are advocated by those who believe that the government should do for the citizens what the citizens should do for themselves. There is a place for public improvements. But there is a place for private initiative. There is no place for regimentation.

2. Authorities contemplate uncontrolled bureaucracy that leads to irresponsible bureaucracy. Authorities are the dream of bureaucrats. They involve the establishment of a super-agency responsible to no one but itself.

3. Authorities involve the establishment of independent agencies. Duplication is thus promoted.

4. Generally the selection and improvement of projects would rest with the authority rather than Congress. I believe in definite appropriations for definite purposes. Public projects should be safeguarded. The Representatives of the people who levy the taxes should have a voice in the approval of construction. Advocates of authorities frankly admit that projects that they promote would not stand the scrutiny of either Congress or a thorough investigation, or the blessed sunlight of publicity. We have had enough of lump sum appropriations. We have had enough of projects without previous Congressional authority.

5. Under existing law the Secretary of Agriculture and the Secretary of War submitted their studies and surveys to Congress. Under the authorities these departments would be subjected to the control of an independent agency.

6. Authorities involve directors. A divided authority is worse than no authority at all. We have the experiences of differences among the directors of the Tennessee Valley Authority in mind when we make this statement. We do not want an unfortunate situation multiplied by 3 x 7 or 3 x 9 times in flood control and conservation work.

7. Major functions can not be well grouped. There is a difference between planting trees and cultivating fields and the construction of levees and the building of dams. They can be coordinated. If an authority is necessary to coordinate, we might as well combine the Department of Agriculture and the Department of the Interior. They must cooperate. If they do not, the remedy is not to scrap the department, but it is for the executive to insist upon cooperation.

8. The function of the Corps of Engineers as well as the Bureau of Reclamation would be subject to the authorities. They would be stripped of their powers. The Corps of Engineers is essential in war. Armies advance as a result of their works. They are largely responsible for victory. They can better aid in war if they are experienced in peace. The Corps of Engineers can best be utilized in public works in time of peace and would be prepared for war. They should always be under the supervision of the Secretary of War. Congress in the future, as in the past, will protect the functions of the Corps of Engineers.

9. I believe in reducing instead of increasing bureaucracy. I believe in accountability for public expenditures. I oppose lump sum appropriations. I believe in utilizing the existing proved and tested agencies of the government in public improvements rather than the establishment of new, untried, and experimental agencies like authorities.

10. I oppose authorities because the bills that provide for them are usually enveloped in vague phraseology. Flood control acts are in brief, clear, and simple language, easy to understand. Behind the vague language is the requirement that the government underwrite the entire cost of improving and developing natural resources and of engaging in activities that are not considered by patriotic tax-paying Americans as proper governmental functions.

11. The placing of all improvements, as well as activities, not strictly governmental in a super-authority means discrimination and the sacrifice of efficiency.

12. Authorities are theoretical. They involve professional planners. Congress does not receive definite information or reports. Improvements that are impractical and expenditures that are wasteful are often made.

Authorities involve the remaking of governmental functions to conform to the ideas of the so-called advance and vociferous planners and spenders.

13. Authorities on the tributaries of the Mississippi River could be so operated as to threaten, if not wreck, the adopted flood control project in the Lower Mississippi Valley. It is essential that the improvements on the river and its tributaries be under the agency that planned and supervised the construction of the improvements.

14. Finally, authorities delegate functions that should be retained by Congress.

Substitute of the Interior Department

In his report and in his statement, the distinguished Secretary of the Interior, Honorable Harold L. Ickes, opposes the pending Murray Missouri Valley Authority Bill, and in his able opposition explodes the theory upon which the bill is based. While proclaiming loyalty and allegiance to the authority plan, he condemns the Murray Bill, which is the latest edition of the authority idea. I agree with his opposition. He opposes a board and advocates a single administrator in the authority.

Secretary Ickes pointed out that there would be no correlation between the Missouri Valley Authority and other proposed authorities. I agree.

Again as I interpret his statement and his report, under the proposed Murray Bill the plans of the Bureau of Reclamation and the plans of the Corps of Engineers for the Missouri Valley might be scrapped. The Murray Bill would also transfer the functions of the Bureau of Reclamation to the authority. He opposes the Murray Bill and I agree in his opposition. I could not criticize the Murray Bill as well as he. The criticism of the Secretary of the Interior is constructive.

The Secretary of the Interior proposes a substitute. He recommends a Regional Authority Act which he has drafted. The drafting bears all the earmarks of the Mississippi Valley Committee and the National Resources Planning Board which Congress has repudiated. The substitute provides for an administrator instead of a board of directors in the authority.

In order to provide the correlation of activities, the substitute provides for a development board. This board would consist of the Secretary of the Interior, the Secertary of Agriculture, the Chief of Engineers, the Chairman of the Tennessee Valley Authority, and the administrators of the authorities created by the act or subsequently created under the terms of the act. The language as to the authority of the board is rather vague. The power and authority of the board to cooperate and to correlate is indefinite.

I notice but one other provision in the proposed substitute. It provides for transferring the functions of the Corps of Engineers to the Department of the Interior.

But the essence of the substitute is that the administrator of the authority shall be under the Secretary of the Interior. The proposed authority is all wrong, according to the Secretary of the Interior, unless that authority is under the supervision of the Secretary of the Interior. As administrator of public works, Secretary Ickes handled lump sum appropriations. He is enamored of such appropriations. In all fairness, the Secretary of the Interior, able administrator that he is, has not refused additional functions or additional power and authority. In fact, he has welcomed power and he has welcomed authority. His substitute involves proposals that have been repudiated by Congress repeatedly. Congress repudiated the proposal in rejecting the Public Works Administration under Herbert Hoover when the opponents of the Corps of Engineers sought the cooperation of that great civilian engineer. Congress rejected not once, not twice, but many times, the authority plan when proposed by the planning agencies and spenders under the administration of President Franklin D. Roosevelt primarily because he advocated the Tennessee Valley Authority.

If the proposed authority is to be placed under any department of the government, it occurs to me that it should be placed under a department whose functions apply in every state. Reclamation is confined to the west. There is no reclamation in the rivers flowing into the Gulf and into the Atlantic. It obtains in about ¼ of the states. On the other hand, the Secretary of Agriculture and the functions of his department affect every state in the Union. No one department is indispensable in supervision. While modest, the Secretary of the Interior naturally believes that an authority could not function unless it was under his supervision. The indispensability of any one department is one of the principal vices of the proposed substitute.

Again the Secretary condemns the director or board idea in the authority. He invokes in the development board the very plans that he condemns in an authority. If the board plan is untenable in an authority, it is equally untenable to supervise the authority. It is easy to read between the lines. If the Secretary of the Interior supervises and controls the administrators of the authority and if the administrators predominate on the board as they most assuredly will if authorities are authorized, it means placing all of the flood control, reclamation, soil conservation, reforestation and allied activities under the Secretary of the Interior. If he controls the administrators of the authority he would control the board. But I repeat that if the board idea is unsound in an authority, it is unsound to provide a board for the correlation, coordination and cooperation of the authorities.

In substance and in summary, the proposed substitute of the Secretary of the Interior seeks to control the superorganizations and the power incidental thereto that the distinguished Secretary himself condemns in the proposed authority. The power of the administrator of the authority would be great, but the

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Notes on Poli-purpose Dams

THE term multiple-purpose dam (or more accurately poli-purpose dam), sounds as if the same dam might be made to do two or three jobs for the price of one. Actually the several objectives of combination dams require different and to a large extent conflicting characteristics in the works that must be built to realize them.

1. Hydroelectric Power Production

The greatest demands for electricity in most sections of the country occur in midwinter when the days are shortest and in midsummer when air conditioning and refrigeration are important. The demand for electricity is generally lowest in the spring.

Where stream flow is regulated by reservoirs for power production the object is to retain the high water flow usually occurring in the spring to augment the stream flow during the periods of low water usually occurring in the later summer or fall and in the dead of winter when streams are frozen up.

2. Navigation

Navigation calls for channels of adequate depth and width available if possible at all times except when ice stops waterborne traffic. It prefers low channel velocities and low or moderate "lifts" at dams.

When stream flow is regulated by reservoirs as an aid to navigation, the object is to retain part of the high water runoff in the spring and possibly all or part of the winter flow to augment the periods of low water flow in the late summer and fall. This release of water conforms in large part with the needs of hydroelectric power production but it may conflict with the need for release of stored water for power production in midwinter when channels are icebound.

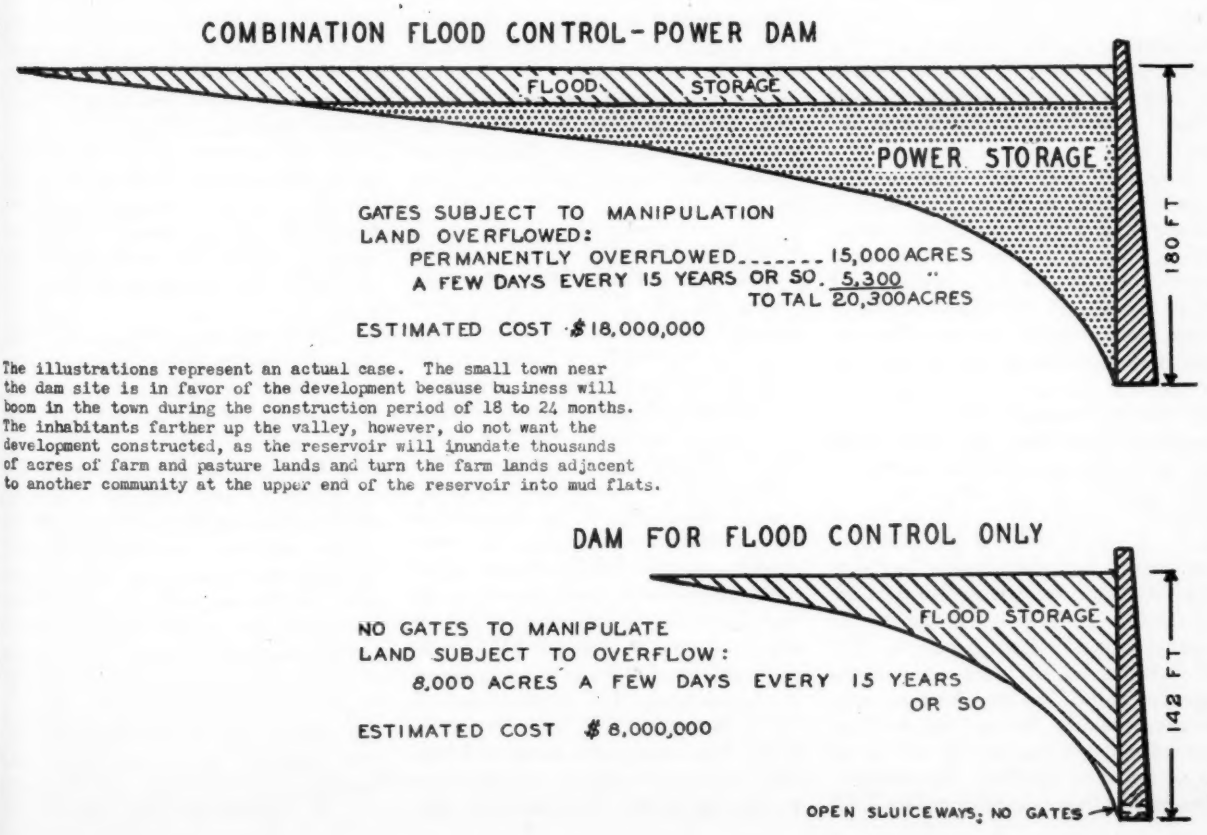
Low dams are usually preferable for navigation. Higher, and therefore more costly, dams are desirable for power development. The added height increases the power output. During high water, low dams may be drowned out entirely.

3. Irrigation

Irrigation requires water for the growing season only and in many localities involves the storage of water for seasonal use. Water is usually being stored for irrigation and hence not available for power production in the fall and winter at the very time when power demand is high.

4. Flood Control

Flood control works should generally be planned to get rid of water as quickly as possible without damage to life and property. When reservoir storage is used for flood control the storage space should be kept empty, ready to detain flood waters temporarily. The flood forecaster can never be sure after heavy rains have sent high water down the streams that more heavy rains will not bring still higher water and then still more flood rains will come. Hence it is generally wise to arrange for the stored flood water to empty out as fast as the carrying capacity of the river


COMBINATION FLOOD CONTROL - POWER DAM
FLOOD STORAGE
POWER STORAGE
180 FT
GATES SUBJECT TO MANIPULATION
LAND OVERFLOWED:
PERMANENTLY OVERFLOWED..... 15,000 ACRES
A FEW DAYS EVERY 15 YEARS OR SO. 5,300 "
TOTAL 20,300 ACRES
ESTIMATED COST $18,000,000
DAM FOR FLOOD CONTROL ONLY
FLOOD STORAGE
142 FT
NO GATES TO MANIPULATE
LAND SUBJECT TO OVERFLOW:
8,000 ACRES A FEW DAYS EVERY 15 YEARS OR SO
ESTIMATED COST $8,000,000
OPEN SLUICEWAYS; NO GATES

The illustrations represent an actual case. The small town near the dam site is in favor of the development because business will boom in the town during the construction period of 18 to 24 months. The inhabitants farther up the valley, however, do not want the development constructed, as the reservoir will inundate thousands of acres of farm and pasture lands and turn the farm lands adjacent to another community at the upper end of the reservoir into mud flats.

channel below the dams will permit, although this may actually result in augmenting flood heights at points considerably farther downstream.

* * *

As a rule the property benefited by flood control reservoirs has not been able to pay their cost. Some localities, notably Dayton, Ohio, have successfully built flood detention reservoirs. Significant benefits from flood storage reservoirs are rather limited to areas not too far below the reservoir site and the big floods, the ones which cause the serious damage, occur on the average at such long intervals that the annual charges on the protective works prove too large to be paid by the property directly and indirectly benefited. Therefore, as a general rule throughout the world the best and most economic flood control measures have been to keep structures as far as practicable out of the flood channels of rivers and to supplement this by building levees or dikes to protect the more valuable land and other property.

In a true flood control reservoir no power facilities would be provided because there would be open sluiceways at the bottom of the dam designed to release water as fast as the channel below could take it and, therefore, the reservoir would be empty except for a few days once in several years. The reservoir site can be farmed because it contains water so little of the time and flood storage usually occurs prior to or early in the growing season.

A straight power reservoir should be kept as near full as the stream flow compared to the power demand will permit. In a combination flood control and power reservoir the flood storage must be at the top of the reservoir. There should be provided, but generally, are not, open sluiceways at the bottom level of the flood storage space to assure the fact that no attempts will be made to impound water above that level except for the one purpose of flood control.

Norris Dam

To illustrate the relative cost of a combination dam and a simple flood control dam, take the case of Norris Dam on the Clinch River, a tributary of the Tennessee not far from Knoxville. The U. S. Bureau of Reclamation, at the request of the TVA, submitted a report showing that the Norris Dam for flood protection only could be built at that site at a cost of $7,150,000. The combination Norris Dam as constructed by TVA cost more than $37,000,000. Another combination dam is the proposed Allatoona Dam in Georgia, on the Etowah River not far from Atlanta. As a combination flood control and power dam the cost is estimated at $18,000,000. As a simple flood control dam its estimated cost is $8,000,000.

Allatoona Dam

The plans for the Allatoona Dam illustrate another serious consideration when power and flood control are combined at the same dam. The first plan submitted by the Army Engineers for a combined power and flood control dam at this site provided for 16,000 kw of generating capacity and 422,500 acre-feet of flood storage. After their report had been reviewed by the Federal Power Commission and referred back for further investigation, the recommendation for installed power capacity became 75,000 kw and the recommended provision for flood storage capacity at the dam was reduced to 212,000 acre-feet. The urge to get more power had already tempered the judgment of the engineers as to the desirable provision of flood storage to cause them to reduce it by half. How much flood storage capacity do you suppose would be preserved in practice after several years had gone by? The temptation to manipulate the water levels and to outguess the weather man would be strong since the big floods occur on the average many years apart. This whittling down or robbing the flood storage capacity is illustrated in the experience with the Grand River Dam.

Grand River Dam

In 1937 the Public Works Administration of the Federal Government loaned money to the Grand River Authority, a state body, to build a power dam on the Grand River in northeastern Oklahoma. The Authority refused to accept a license for the dam unless the power pool was raised to elevation 745 to make the development more attractive financially. The Army Engineers stood out for keeping the power pool at elevation 735 but finally agreed under protest to a license issued by the Federal Power Commission raising the power pool up to elevation 745. A big flood caught the reservoir operating at the higher level. The estimated damage in the Arkansas basin, according to the Army Engineers, was about $33,000,000. Colonel George R. Goethals reported that if the dam had been operated at elevation 735, as recommended in the report approved by Congress, the crest of the flood at Fort Smith would have been reduced by one foot.

Buchanan Dam

In 1938 a disastrous flood occurred on the Lower Colorado River in Texas, and the great extent of the damage was blamed on the Buchanan Dam of the Lower Colorado River Authority. At a mass meeting in Austin, Texas, on July 30, one H. B. Armstrong declared that officials of the local station of the Weather Bureau told him that the flood stage would have been at not to exceed 19 ft instead of reaching 34 had the flood gates of Buchanan Dam been lifted earlier. Answering the mass meeting, the Lower Colorado River Authority adopted a resolution declaring that it was the responsibility of the Authority to operate the project to produce revenue to liquidate its indebtedness and that the Authority should not be driven from the field of public service.

Army Division Award to Baltimore Company for Top Blood Donor Record

THE Consolidated Gas Electric Light and Power Company of Baltimore has been awarded a plaque by the 29th Division Association in recognition of the firm's "excellent cooperation given the blood donor project." Coincident with the award made to the utility, 46 of its employees—members of the Gallon Club—were presented individual plaques at exercises held in the Maryland Casualty Auditorium. The company now has 86 Gallon Club members with more becoming eligible every week.

Four Two Gallon Club members employed by the company also were honored. They are: Michael A. Pusateri, J. Theodore Wolfe, Vernon R. Smith and John C. Snyder.

Henry R. Cook, Jr., vice-president of the utility, in accepting the plaque for the company emphasized that all employees had given their blood voluntarily; although the company had given the effort widespread publicity and allowed employees who donated their blood time off with full pay to make the donation.

In making the awards, William C. Nicklas of the 29th Division Association pointed out that the Gas and Electric Company has more Gallon Club members than any other organization of

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Electric Power Problems Encountered by the Constructors of the "Big Inch" and the "Little Big Inch" Pipelines

By W. H. Stueve

Chief Power Consultant, Oklahoma Gas and Electric Company

ONE of the most interesting war projects, which later became an absolute necessity after Pearl Harbor, was the construction of the "Big Inch" oil pipe lines to supply the armed forces in Europe and Africa and civilian population of the Eastern Seaboard.

The entire project involved using about 500,000 tons of steel, securing 230,000 hp of electric power capacity and requiring an investment of almost $150,000,000 to complete. Interest of the tax-paying, business-managed power companies lies in the fact that this project is the largest industrial electric development of its kind using purchased power exclusively.

Many articles have been published relating to the reason for constructing the 24-in. Big Inch and 20-in. Little Big Inch pipe lines, also descriptive articles and advertising of the equipment installed under auspices of the manufacturers have appeared in trade publications at various times since July, 1942, when a private corporation, known as War Emergency Pipelines, Inc., was delegated with authority by the Petroleum Administrator for War to proceed with the construction of these projects. This private corporation was formed by eleven of the larger integrated oil companies having oil production and refineries in the Southwest and who also operated refineries and owned marketing facilities in the Great Lakes and Eastern Seaboard areas. Defense Plant Corporation was authorized to furnish the funds for construction by the Reconstruction Finance Corporation.

The staff of executives and engineers selected to construct the pipe lines was drawn from the ablest and most experienced men in the oil industry transportation field. The General Manager was B. E. Hull, President of Texas Pipe Line Company of Houston. His assistant was Major A. N. Horne, released by the Army and formerly manager of Empire Pipe Line Company of Bartlesville. Chief Engineer of the entire project was Oscar Wolfe, Chief Engineer of Texas Pipe Line Company of Houston.

Up to this time, very little information has been made available to the public that would portray the important part played by the privately owned and tax-paying power companies, in making the flow of oil and/or oil products, through the Big Inch Pipe lines, to the East Coast possible.

Many of us recall the hue and cry of certain agencies in Washington in 1941 to the effect that a power shortage existed, and that the war effort would be hampered because of the shortsightedness of the executives of the tax-paying privately-owned power companies for not having ample capacity available for the war effort.

These two pipe lines required ultimately 228,900 hp at 33 locations, and in some cases the stations were in sparsely settled country, at intervals of 50 miles apart in eight states. Capacities ranging from 3750 hp to 8250 hp per pump station were required. To the credit of business-managed power companies, all pump stations were supplied with ample power capacity from existing steam generating stations, without adding any generating equipment. The power companies readily responded to our inquiries for capacity and were eager to supply the power requirements of the pump stations to help in the war effort.

The engineering staff, of War Emergency Pipelines, Inc., reached a decision that the use of the single-stage centrifugal pump operated at 1785 or 3570 rpm was desirable and most efficient to handle the large required volume of 300,000 barrels per day (8600 gpm), the maximum design capacity of the 24-in. Big Inch Line. The capacity of the 20-in. line was 235,000 barrels per day.

The internal-combustion-engine type station for the 24-in. line would have required four 1800 hp engines, which included one standby unit, each medium-speed engine driving the single stage 1800 rpm centrifugal pump through speed increasing gears. Such type of station represented a cost of four times the electric motor type station.

The steam turbine type of station, with three 1500 hp turbines direct drive to the centrifugal pump, and including a standby boiler, represented a cost of almost five times the electric-motor type station.

From Table I, it can be noted that the only station containing spare motors is at No. 21 on account of the high static pressure required to pump over the Allegheny Mountains, which required all three motors to operate for any value of lower capacity. The distance from Station No. 21 to No. 22 was only 30 miles, or about 58 per cent of the conventional station spacing of 52 miles.

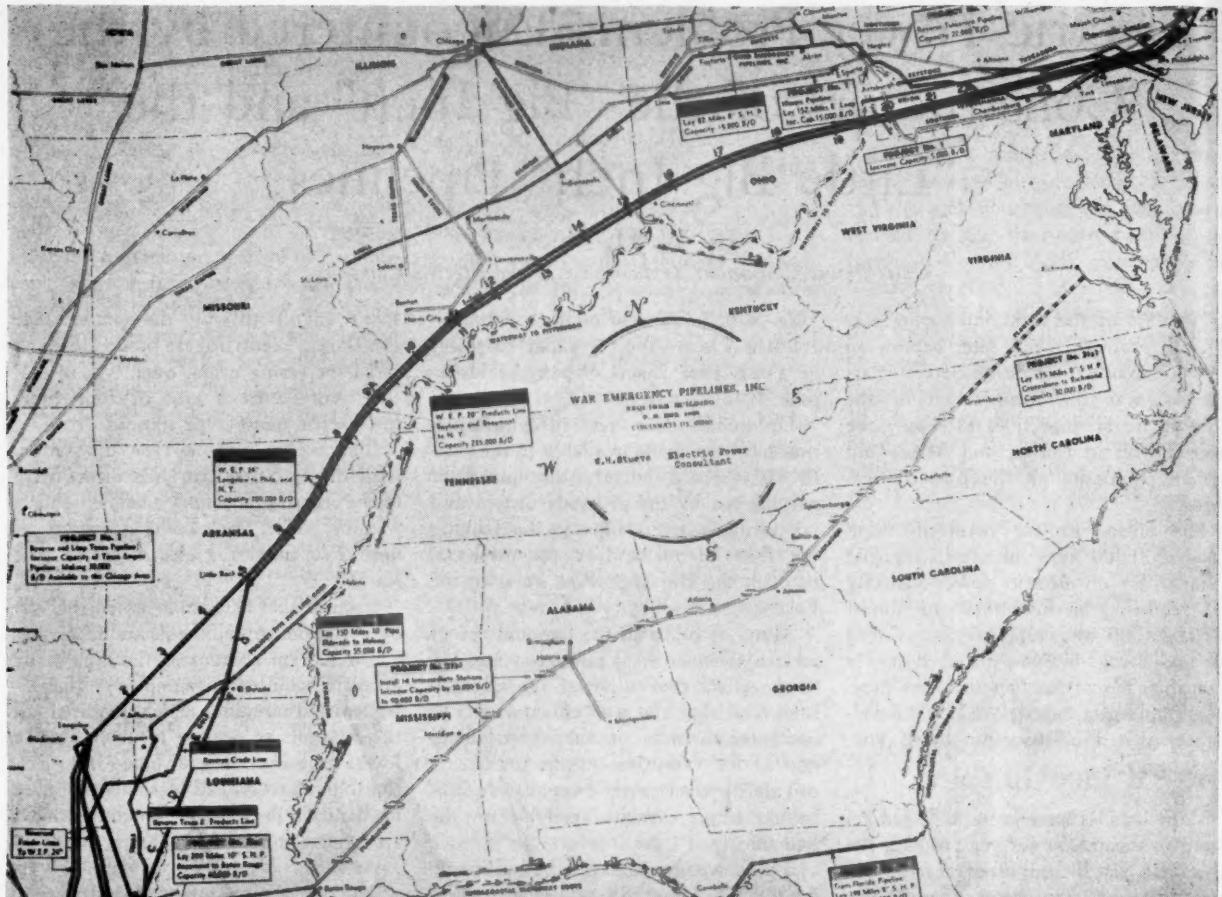
Factors of investment, fixed charges, labor, maintenance, fuel, and 10-year depreciation, were all given consideration.

The power companies in most cases had available suitable industrial rate schedules. In a few instances, however, certain changes were made to allow for the unusually high load factor operation.

These changes did not affect the average industrial establishment which usually operates at lower load factors than pipe lines.

As stated previously, the motor-driven centrifugal pump station could be said to compete successfully with other forms of prime movers, the Diesel Engine and steam turbine. The results of the completed contracts indicate the use of motors was a wise choice.

The matter of the so-called inflexibility of operation, when using constant speed induction motors for pipe line service is sometimes pointed to by proponents of the Diesel Engine or steam turbine prime movers, as being a serious handicap to the economic operation. They contend that when capacity changes are necessary, the speed of the engine or



Pump Stations on the Big Inch and Little Inch pipelines are designated by letters A to G inc. and numbers 1 to 27 inc. See Table I on opposite page.

turbine can be lowered to fit the new condition, whereas with the induction motor drive the discharge has to be throttled with the consequent loss of electric power. The experience of the electric motor operated Big Inch pipe lines indicates the matter of speed control is not a serious objection to the use of motors. In the case of the Big Inch stations, each station containing three pumps to be operated in series, each pump handles the maximum design capacity of the line, but produces only one-third of the total pressure required, when two motors are used in each station along the line, there is a loss of only 17 per cent in capacity. Likewise, if only one motor is operated in each station along the line the loss in capacity is only 45 per cent.

Many other capacity changes can be made by various combinations of motors and stations used, such as three motors in operation at alternate stations will deliver within 30 per cent of the maximum design capacity. Sufficient flexibility in operation, by selecting the number of motors operated, is afforded to make the electric pump station as flexible as engine or turbine drive stations.

The complete story of obtaining electric power supply for the Big Inch pipe lines can not be told properly unless some of the difficulties encountered during the construction period are disclosed. For instance, certain rural electric associations, through whose territories the pipe line passed, made proposals to supply power for seven of the 4500 hp and 8250 hp pump station locations. They also offered contracts to maintain and operate the power lines required to serve such pump stations. The ridiculous part of these proposals is that these rural associations did not own generating plants anywhere in the states, in which the pump stations are located, neither were their power lines capable of transmitting capacities to start motors of much more than 25 hp. All efforts by these associations, to complete power contracts, were cast aside purely on basic engineering conclusions after giving due consideration to their inexperience in power matters and type of service offered when line disturbances occurred.

Among some of the construction difficulties encountered were problems pertaining to obtaining proper type of conductors for the power lines, and also limitations placed on the use of steel and wood timbers for the substations and pole lines.

The following is a list of limitation orders given out by the War Production Board as applied to our electric construction:

1—All transmission lines were to be built with steel conductors.

TABLE I
WAR EMERGENCY PIPELINES, INC.

Capacity Required, Power Supplier for each Pump Station, Voltage of Power Line, Meter Contract Delivery Voltage and Life of Power Contracts. KW for 24-Inch Stations 300,000 B/D at 700#—KW for 20-Inch Stations 235,000 B/D 700#

Station	Power Supplier	Each Station KW	KV of Metering and Hi-Line Supply		Years Term of Contract	Horsepower Connected Per Station	
			Meter	Hi-Line		24"	20"
A	Houston Pr. & Lt. Co.	1710	2.4	66	1	.....	2100–150
B and C	Gulf States Utilities Co.	3000	2.4	33–66	1	.....	3750–300 (B)
D and E	Louisiana Pr. & Lt. Co.	3000	2.4	110	1	.....	3750
F and G	Arkansas Pr. & Light Co.	3000	2.4	110	1	.....	3750
1 and 2	Southwestern Gas & Elec. Co.	3600	2.4	66	1	4500– 300 (1)	.....
3 and 4	Arkansas Power & Lt. Co.	3600	2.4	110	1	4500	.....
5 and 6	Arkansas Power & Lt. Co.	6600	2.4x	110	1	4500	3750
7 and 8	Arkansas-Missouri Pr. Corp.	6600	2.4x	110	1	4500	3750
9	Arkansas-Missouri Pr. Corp.	4282	2.4	*110	...	3000	3750
9-A	Missouri Utilities Co.	2400	2.4	33	1	1500	.....
10	Central Ill. Public Serv. Co.	6890	66	**66	1	4500	3750
11	Central Ill. Public Serv. Co.	6600	66	66	1	4500–1500	3750– 300
12-13-14-15	Public Serv. Co. of Indiana	6600	2.4x	33	1	4500	3750
16	Cincinnati Gas & Elec. Co.	6600	2.4x	66	5	4500– 100	3750
17	Columbus and So. Ohio Elec. Co.	6600	69	69	5	4500	3750
18 and 19	The Ohio Power Company	6600	69	69	2	4500	3750
20 and 21	West Penn Power Company	6600	25	25	5	4500–1500 (21)	3750–1250 (21)
22	Pennsylvania Electric Co.	6600	22	22	1	4500– 100	3750
23	Southern Pennsylvania Pr. Co.	***4400	2.4x	69	1	4500– 100	3750
24	Pennsylvania Pr. & Lt. Co.	6600	69	69	1	4500– 100	3750– 150
25	Philadelphia Electric Co.	6600	33	33	1	4500	3750
26	New Jersey Power & Light Co.	6600	33	33	1	4500– 500	3750
27 Linden	Public Service Corp. of N. J.	1000	26	26	1	800	400
		178,480				120,500	108,400

x-The 2400 volt meters in the 24" and 20" substations were duplexed.
*55 miles line losses (82 kw) for 1200 kw at 9A and 3000 kw at 9 to be added to 2.4 kv meter readings for total load 24-inch and 20-inch line for rate comparison.
**9 miles line losses (290 kw) for 6600 kw at 10 added for rate comparison.
***Only two 1500 hp motors required normally in 24-inch station and two 1250 hp motors required normally in 20-inch station.

2—No static wires would be permitted for lightning protection.

3—Formed or sawed cross-arms were not permitted—required to use spars.

4—Buried dead-men, instead of metallic anchors, were to be used with downguys.

5—All oil circuit breakers to be eliminated at feeder taps.

6—Steel members could not be used for substation erection, consequently creosoted poles or spars for structures were used.

7—Wood fences to be used around all substations.

8—Three-phase transformers were required at each pump station, instead of conventional single-phase units.

9—Substations to be built within 25-feet of pump house to reduce length of copper secondaries. Ordinary safety measures in pipe-line practice would place the substation at least 100 feet away.

10—The large 1500 and 1250 hp motors to be standardized for dimensions, using minimum copper and iron, yet, they had to be 94 per cent efficient.

11—No motor operated gate valves for the 24-inch line were permitted. All were hand operated.

Many other orders of more or less minor importance were issued, but the above eleven proved of primary concern. The War Production Board's orders were adhered to in all cases, in so far as possible. The steel conductor was used for the power lines serving stations Nos. 1, 2, 3, 4, 5, 6, 9-A, 10, 11, and was expected to be used on lines to serve Nos. 7, 8, and 9, but since the loads at these locations had to be increased 9000 kw on account of adding the 20-inch pump stations of 3750 hp each, it was found inadvisable to try to use the one-half inch steel conductor and ACSR and Copperweld conductors were allowed.

Other changes from the original orders: To increase the distance of the substations from the pump houses from 25-feet to 100-feet on the 20-inch products station pump houses.

Lightning protection on some of the longer power lines was accomplished, later by using inexpensive protector tubes, mounted at intervals of about one mile, excepting the river crossing structures.

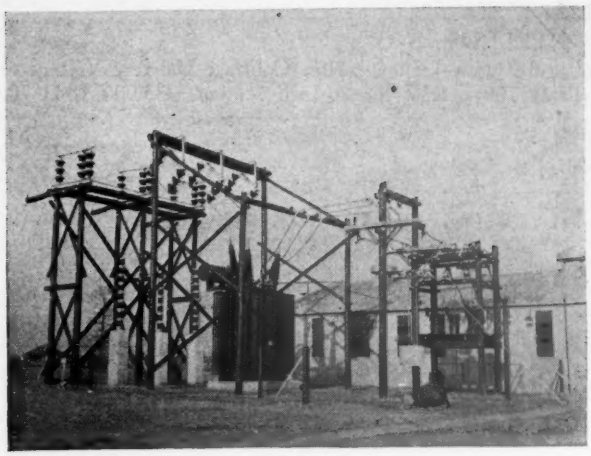
Motor-operated gate valves were permitted in the 20-inch products line pump stations.

All the transformers, for both the 24-inch and 20-inch pump stations, were the three-phase type, equipped with air blast attachments, since in the case of the 24-inch stations, containing three 1500 hp motors, the loads were estimated to approach 4000 kva, a slight overload under normal operating conditions. In the summertime, when pumping light crude oil of low viscosity, we estimated the transformers would be overloaded perhaps 12 per cent when the oil deliveries reached 320,000 barrels per day.

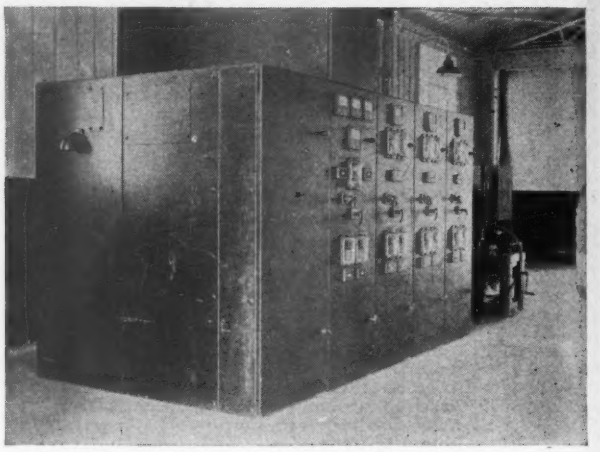
The limitation orders of the War Production Board, however, did not affect the use of proper type switchgear, since we installed either "across the line" or the more expensive "reduced voltage" type, whichever type the power supplier recommended as being most suitable to fit his transmission system conditions.

We were also permitted to purchase several spare transformers which were designed for use on the different power systems' primary lines. The spare transformers were geographically located along the pipe line to be used for emergency purposes.

The 20-inch products line was not authorized until December, 1942, almost six months after the 24-inch Big Inch crude line was authorized, and the



Typical 110-kv Substation, showing proximity to pump house, 3750-kva, 3-phase transformer, wood spar structure, air switch and lightning arresters. Wood picket fence installed later.



Typical "Across-the-line" switchgear panels. Incoming line panel 1200 ampere. Individual panels for each motor 600 ampere. All OCB 100,000-kva Interrupting capacity. Each panel equipped with kw—kwh—volt and ammeter.

"across the line" switchgear had been purchased for the pump stations which were supplied at 110 kv located in Arkansas. When the 20-inch products stations were added to the power suppliers system in Arkansas, it became necessary to install 12,400 kva of capacitors to insure sufficient starting voltages at Stations Nos. 7, 8, and 9. These capacitors were required especially during the rice irrigation and cotton ginning season. Another 2000 kva installation of capacitors was required at Station No. 20, located in the mountains south of Pittsburgh and served through a ten-mile 25-kv power line originating at a rather weak point in the power supplier's transmission system. These capacitors and necessary circuit breakers were readily allocated by the material section of War Production Board.

In reviewing Table II, the effect of population density can be noted in the supply voltages available for power loads of the size required in the pump station of the Big Inch lines, for in the relative sparsely settled states of the Southwest 110 and 66 kv prevail; whereas, in Pennsylvania and New Jersey the supply voltages decrease to 33 and 22/25 kv.

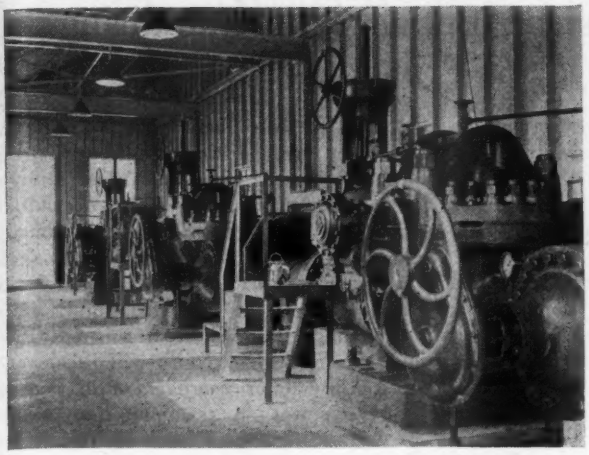
Practically all power supply lines, installed to serve the first eleven stations for the 24-inch line, are owned by Defense Plant Corporation. This was brought about by the manner in which the construction was authorized, and was not due to any desire on the part of the present owners. The first eleven stations required were for 550 miles of 24-inch line terminating at Norris City, Illinois, leaving the project an uneconomical installation and a very short-term arrangement; consequently the power suppliers were reluctant to make investments in service lines and/or substations for what appeared to be short-term business. Note that after the project (24-inch line) was authorized to terminate

TABLE II

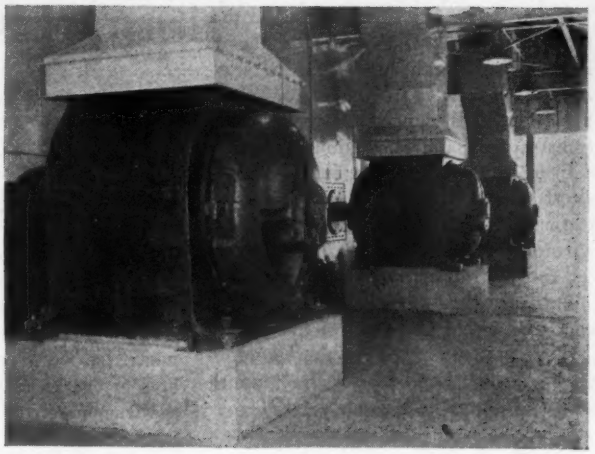
Miles of Power Supply Lines, showing Voltage, Ownership, and those Prepaid in Part by Defense Plant Corporation.

Longview to #5 24"	Houston-Beaumont to #5 20"	Power Supplier	Supply Line Voltages (KV) 110	66/69	33/34.5	22/25	Ownership Power Co.	D.P.C.	Prepaid
1		SW Gas & Elec. Co...		.6				—	
2		SW Gas & Elec. Co...		2.3				—	
3		Arkansas Pr. & Lt....	6.9					—	
4		Arkansas Pr. & Lt....	12.7					—	
	A	Houston Ltg. & Pr...		1.0			—		
	B	Gulf States Util.....			2.0		—		
	C	Gulf States Util.....		49.0					—
	D	Louisiana Pr. & Lt...	54.0						—
	24" E	Louisiana Pr. & Lt...	28.0						—
	& F	Arkansas Pr. & Lt....	7.0				—		
	20" G	Arkansas Pr. & Lt....	4.0				—		
*5		Arkansas Pr. & Lt....	.1					—	
6		Arkansas Pr. & Lt....	1.2					—	
Walnut Ridge		—	TAP					Sub. Sta.	
7		Arkansas-Mo. Pr.....	13.8					—	
8		Ark-Missouri Pr.....	51.2					—	
9-9A**		Ark-Missouri Pr.....	55.0					—	
10		Cent. Ill. Pub. Ser....		9.0				—	
11		Cent. Ill. Pub. Ser....		.2				—	
12		Pub. Serv. of Ind.....			3.0		—		
13		Pub. Serv. of Ind.....			8.0		—		
14		Pub. Serv. of Ind.....			.5		—		
15		Pub. Serv. of Ind.....			10.0		—		
16		Cincinnati Gas&E.Co.		10.0			—		
17		Col. & So. Ohio E. Co.		16.8					—
18		The Ohio Power Co...			3.0		—		
19		The Ohio Power Co...			17.0		—		
20		West Penn Pr. Co....				10.4			
21		West Penn Pr. Co....				1.0	—		
22		Penna. Elec. Co.....				3.0	—		
23		So. Penna. Pr. Co....		.5			—		
24		Penn Pr. & Lt. Co....		4.0			—		
25		Philadelphia Elec. Co.			10.3				—
26		N. J. Pr. & Lt. Co....				1.0	—		
Linden, N. J.		Pub. Serv. Elec. & Gas				.2	—		
			233.9	93.4	53.8	15.6	85.6	153.0	158.1

*Little Rock
**9A served at 33KV Missouri Utilities Co. 3000 H P or Standby.



Pump Side of Pump House for 24-Inch Big Inch Line
Note fire wall, and hand-operated gate valves on suction and discharge side of each pump. Each pump delivers 300,000 barrels per day at 240 lb.



Motor Side of Pump House for 24-Inch Big Inch Line
Note fire wall and shield where shaft passes through wall. Air ducts for carrying away heat losses above motors. Each motor 1500 hp., Efficiency 94.2 per cent, Power Factor 91.8 per cent, 1785 r.p.m.

at Eastern tidewater, all power supply lines from No. 12 to East were constructed on a revenue basis by the power suppliers. The economic life of the final project was quite different from that of the original proposal.

In the case of the power lines prepaid by Defense Plant Corporation, it should be explained that the investments were too great to justify the power suppliers absorbing the cost, particularly in the cases of Station "C," "D," and "E" on the 20-inch products line, where the power line costs were about ten to twenty times the expected annual revenue.

In the case of Station No. 17, the power line cost was originally six times the expected revenue and the facility agreement was based on that premise, however, six months later when the 20-inch line was projected, the additional revenue from the added 3750 hp of motors changed the picture. Excessive right-of-way costs for the power line serving Station No. 25 made it imperative that a partial prepayment absorb such costs.

The total amount of power line installed to serve the 33 power delivery points was 396.7 miles, or an average of 12 miles per location.

Power for Stations No. 7, No. 8, and No. 9, was taken at 110 kv at Walnut Ridge (Hoxie, Arkansas).

The only change made from the original design of the pipe line was the combining of a station known as No. 9-B, containing two 1500 hp motors for operation of the 24-inch line, with station No. 9-A containing one 1500 hp motor. Station No. 9-B was located just east of the levee along the Mississippi River and pumped two-thirds of the conventional station spacing or about 33 miles to Station No. 10.

The power line consisted of 18 miles of ½-inch steel conductor 66-kv originating at a common tap point nine miles west of Station No. 10. The flood of May, 1943, completely covered all equipment in the station and materially reduced the capacity of oil handled. To eliminate this hazard, Station No. 9-B was abandoned and Station 9-9A made a full pressure-capacity station for both lines.

In reviewing the scope of this war project, and to gain some idea of its enormity, the adjoining Table III is submitted for the detailed cost of the electric work performed on a cost-plus-fixed-fee basis by the L. E. Myers Company of Chicago.

TABLE III

Electric Construction and Equipment Costs to Supply Service for 24-Inch and 20-Inch Stations

396.7 miles of power lines (Reference Table II)	$2,375,000
Transforming Equipment, including Spares	560,000
Install Sub-Stations—55 for both lines	500,000
85—1250 HP and 79—1500 HP Main Motors and 5000 HP of Miscellaneous Motors	1,425,000
Reduced Voltage and Across Line Switchgear	1,290,000
Capacitor Installations—14,400 KVA	150,000
Interior Station Wiring, install motors and switchgear	460,000
Miscellaneous Motor Operated Valves (20" line), Regulators, Oil Circuit Breakers, Lighting Transformers	120,000
Protector Tube Installations for Lighting Protection	35,000
Total	$6,915,000

TABLE IV

Electric Power Data and Pumping Costs for 24-Inch Line First Eight Months in 1944

1944	Total KW	Kw. Hrs.	L.F.	Cost	Actual ¢/Kwh.	Average Bls./Day	Original Total Barrels	1254 Miles Kwh/Bbl.
January	92,964	59,541,797	85.8	$422,114	.710	280,000	8,700,000	6.85
February	91,880	59,107,402	92.5	411,680	.698	296,000	8,600,000	6.88
March	93,131	60,462,306	87.3	419,324	.694	284,000	8,820,000	6.85
April	91,982	60,717,101	91.7	416,729	.687	284,000	8,550,000	7.10
May	94,225	56,756,927	80.9	409,436	.721	289,000	8,980,000	6.32
June	97,810	61,982,739	88.0	434,038	.701	311,000	9,350,000	6.62
July	98,741	66,035,296	90.0	454,727	.689	313,500	9,720,000	6.80
August	98,566	64,410,244	87.8	447,375	.695	312,000	9,700,000	6.65
		489,013,812	84.5	$3,415,423	.697	296,500	72,420,000	6.75

Power cost from Longview to New Jersey . . . . 4.72c/Bbl.

From Table III, it can be noted that the cost of procuring power at the 33 locations for both pipe lines to serve 229,750 hp is $3,740,000, or about $16.40 per horsepower for power lines, transformers, and substations, ready to deliver 2400 volts to the motors. The electric costs including power lines, substations, motors, capacitors, and station wiring represented only 4.7 per cent of the cost of the entire project.

In order that some idea can be given as to the actual operation of these lines, Table IV is submitted for the operation of the 24-inch line only for the 8-month period, January to September, 1944.

The 20-inch line started operation about March, 1944, and for the first five months operated at decreased capacity of 180,000 bbl. per day with two motors in operation in each station, but since it has operated at its design capacity of 235,000 bbl. per day almost continuously.

By referring to the above table, note that the load factor for the eight-month period (based on July—98,741 kw) is 84.5 per cent, and that the total cost per barrel for pumping 1254 miles from Longview to New Jersey is 4.72c; also that the energy required averaged 6.75 kwhr. Our original estimates were slightly higher, before the line was actually placed in full capacity operation.

Note that the kilowatthour per barrel pumped does not vary a great deal under wide variations in load factor. From all indications the pumps are about 86 per cent efficient and the motors 94 per cent efficient in keeping with design estimates. Also the pressure drop per mile varies between 14 and 15 psi, depending on the viscosity of the oil pumped. At the time of maximum rate of pumping in July, the motors are overloaded only 5 per cent, when the average daily pumping was 313,500 barrels.

When all factors of types of oil pumped, volumes and viscosities, are considered, it may be said that the "Big Inch"—24-inch crude line meets all expectations in the way of efficiencies obtained and that the actual delivery will average 300,000 barrels per day over the year period of 1944.

When consideration is given to the power cost to pump oil or products to the East Coast, and if other proper charges of interest, depreciation, labor, and maintenance are added, the total cost of pumping would be about 15c per barrel, which in turn is slightly less than the average cost to ship by tankers. This cost comparison should give the Big Inch pipe lines a long economic life.

Suggested Appliance Merchandising Principles

AN extended investigation has been made by a committee of Edison Electric Institute of the relationship of the utility and retail outlets in its business development activities. All partners in the selling transactions were taken into consideration. The result of the findings of the committee are expressed in a statement on trade practice which has been distributed to the members of the Institute as a guide in their postwar merchandising plans.

These SUGGESTED APPLIANCE MERCHANDISING PRINCIPLES are presented here with the belief that they are a distinct contribution to advancing the high standard of utility-retailer relationships which the utilities hope to achieve in peacetime selling.

A study of these Principles should convince that many of the irritations created from past trade practices, although justified from a strictly merchandising viewpoint, will be absent in utility-dealer coordination in load development in the immediate postwar years. Local conditions will govern the extent to which the suggestions may be adopted.

Suggested Appliance Merchandising Principles

These suggested merchandising principles have been prepared by the Commercial Division General Committee, Edison Electric Institute, as a guide to member companies in the formulation of their own policies. They are based on the practice of most of the electric utilities engaged in merchandising appliances as a means of increasing use of their service.

1. *Sales Franchises*

The merchandising policies of utilities should provide equal opportunities for dealers to sell any makes of appliances sold by utilities.

2. *Sales Practices*

Appliance sales should be made on the basis of fair and open competition, this being in the interest of the public, of appliance manufacturers, and of all those engaged in the distribution of appliances at wholesale or retail.

3. *Quality of Merchandise*

Appliances offered for sale should be of a quality which will result in safe, dependable and efficient operation.

4. *Appliance Service*

To assure a maximum of customer satisfaction, adequate maintenance service should be made available.

5. *Sales Emphasis*

Electric utilities should plan their appliance sales operations so as to encourage maximum volume by all outlets. Special emphasis should be placed on appliances and equipment not having adequate customer acceptance.

6. *Special Offers*

In planning special offers or sales inducements, the electric company should have in mind the importance of making it possible for retailers to join in, thus stimulating their merchandising activities.

7. *Advertising*

Advertising and displays should, so far as is practicable, recognize and support the retailers.

8. *Deferred Payment Plans*

Deferred payment plans applicable to appliances should be economically sound, and within the financing terms available to retailers. The merit of the appliance, rather than the terms of sale, should be the controlling buying motive.

9. *Dealer Training*

While training of retailer sales personnel is primarily the function of the retailer, wholesaler and manufacturer, utilities should consider offering basic sales training and information on appliance operating costs, on local installation policies and on competitive factors.

10. *Compensation of Salesmen*

In establishing compensation plans for salesmen, practices should be adopted which will lead to good will and understanding between electric utilities, retailers and the public.

The Battle of Power Supply in Britain

*A General Review of Air Raid Experiences**

From the *Electrical Times*, London, of April 5

"With the consent of the censorship it is now permitted to explain the cryptic announcement made some time ago, that during the war electricity distribution in Great Britain has suffered more from friend than foe. The plain fact is that outages on Grid lines, due to the trailing cables of broken-away barrage balloons fouling the conductors, have greatly exceeded those due to bomb splinters and blast, both in number and aggregate duration. Other overhead lines also suffered considerably from the same cause. By way of illustration, in the first year of the war enemy action occasioned 73 interruptions of supply on Grid lines, aggregating 44 hours duration; barrage balloon cables in the same period caused 252 breakdowns lasting in the aggregate 467 hours; that is, more than three times the number of incidents and more than ten times the total outage period. The contrast was not, of course, always so great as this, but overhead line troubles from defence measures have, in general, greatly exceeded those due to enemy action.

"Concerning generating plant damaged or destroyed by enemy action, at no time did this exceed the aggregate of 266,000 kw out of action at the end of October, 1940. This is little more than 3 per cent of the national pre-war installed capacity, and from the standpoint of the Luftwaffe represents a dismal failure. It is not even as good as the effort of the Ministry of Fuel and Power, whose coal controllers, by delivering unsuitable fuel to power stations, reduced generating capacity by 300,000 kw, as well as causing a lot of additional troubles. The official enemy's lack of success would have been even less but for his lucky hit on Fulham power station in September, 1940, which damaged 190,000 kw of plant in one blow. Considering all things, the supply industry survived the air assault on Great Britain magnificently, and to the undying credit of its personnel. At times, however, in view of the experiences referred to above, harassed supply engineers may well have breathed the prayer, "Save Us from Our Friends."—An editorial in the *Electrical Times*, London.

IN what follows an attempt is made to put the whole of the Battle of Power Supply in general perspective. The struggle was a vital one, and it was won decisively. Indeed, considering the magnitude of the efforts put forth by the Luftwaffe, the really surprising thing is that so little serious dislocation of electricity supply resulted. The time period of interruptions was measured in hours, not days or weeks, and after a raid it was rare, indeed, that any consumer was kept waiting for supply when he was ready to take it. Concerning plant out of action, the aggregate never exceeded 266,000 kw, little more than 3 per cent of the pre-war aggregate installed capacity. Apart from the efforts, enterprise and ingenuity of the industry's personnel, the greatest single factor contributing to this success was the existence of the Grid. In its absence there would have been a sadder story to tell.

First Year, 1939-1940

The first year of war, Sept. 3, 1939, to Sept. 1, 1940, passed almost without electrical incident. No generating station nor Grid substation was hit or materially affected until the latter date. Then a bomb in the yard of Gravesend power station caused some minor damage to buildings and interrupted supply on one feeder for 9½ hours. Historically, Gravesend power station was the first to be involved, but there was no damage to generating plant. Actually the h.e. bomb which exploded in the station yards, destroyed a length of 6.6 kv cable, a section of l.t. overhead line, a section of cooling water outlet pipe, and caused minor damage to the station buildings.

During the year Grid lines, and other transmission and distribution systems were affected on a number of occasions, but in comparison with what was to come not seriously. Bombs and bomb splinters, cutting conductors caused 73 incidents involving Grid lines. Important supplies were interrupted on 18 occasions, there were 27 minor interruptions, and on 28 no loss of supply occurred. The aggregate time period of interruptions for the year from these incidents was 44½ hours only.

Damage to Grid lines by barrage balloon cables fouling them was a much more serious matter, as the data in Table IIA show. It will be seen that barrage balloons accounted for nearly four-fifths of the total incidents in the year, and the aggregate duration of interruption was over ten times that due to direct enemy action.

Naturally, other lines and distribution systems were more frequent, but again damage was comparatively light. Out of 297 breakdowns there was no interruption of important supplies, minor interruptions numbered 280, and on 17 occasions no loss of supply occurred. The aggregate time period of breakdown was 2241½ hours.

Damage due to balloon barrage cables was of minor importance on other lines and distribution systems, the number of incidents being 112 and the aggregate time period of interruptions 461½ hours.

TABLE I.—GENERATING PLANT IMMOBILISED DUE TO ENEMY ACTION.

At End of	kW
Year to August 31, 1940 ...	Nil
September, 1940	200,000
October, 1940	266,000
November, 1940	176,000
December, 1940	81,000
January, 1941	135,150
February, 1941	135,150
March, 1941	147,650
April, 1941	154,500
May, 1941	190,000
June, 1941	185,000
July, 1941	182,000
December, 1941	73,000
March, 1942	25,700
June, 1942	11,000
September, 1942	45,000
September, 1943	15,000

September, 1940

In September the Great Blitz on London, and provincial centers, started, and continued into the summer of 1941. The Metropolis took the first shock. Between September 3-30, no generating station or Grid substation was damaged outside Greater London. Inside, 15 power stations and four Grid substations were hit or affected by near misses, some on more

*A series of weekly articles on individual experiences of electricity supply undertakings under air raid attacks has been appearing in the *Electrical Times*, London, since December 14 last. Other articles in the series are awaiting publication in the *Times*.

TABLE II.—DAMAGE TO CENTRAL ELECTRICITY BOARD GRID LINES DUE TO ENEMY ACTION.

	3 Sept., 1939 to 2 Sept., 1940	3-30 Sept., 1940	1-31 Oct., 1940	1-31 Nov., 1940	1-31 Dec., 1940	January, 1941	February, 1941	March, 1941	April, 1941	May, 1941	June, 1941	July, 1941	August, 1941	September, 1941	October, 1941	November, 1941	December, 1941	Jan./Dec., 1942	Jan./Sept., 1943
Important Supplies Interrupted ..	18	73	31	6	4	5	8	13	3	2	4	—	2	1	1	—	1	21	1
Minor Interruptions	27	16	39	21	—	2	7	5	7	26	3	5	—	—	—	2	—	63	23
No Loss of Supply	28	36	11	34	3	5	5	3	13	19	8	6	1	10	—	—	—	65	6
Total Breakdowns	73	125	81	61	7	12	20	21	23	47	15	11	3	11	1	2	1	149	30
Aggregate Time Period of Interruption in Hours	44	28	37	12	34	½	¾	15	8¾	21½	11¾	6½	10	5 min	1	1	6¾	183	—

TABLE IIA.—DAMAGE TO CENTRAL ELECTRICITY BOARD GRID LINES DUE TO BARRAGE BALLOONS.

Important Supplies Interrupted ..	55	27	38	54	15	22	53	16	2	—	2	3	12	6	3	4	5	35	36
Minor Interruptions	97	14	36	75	3	3	19	12	8	17	5	14	48	3	6	5	8	68	90
No loss of Supply..	100	22	8	49	23	12	21	6	19	11	5	3	18	3	2	10	3	61	72
Total Breakdowns	252	63	82	178	41	37	93	34	29	28	12	20	78	12	11	19	16	163	198
Aggregate Time Period of Interruption in Hours ..	467	10	41	116½	18¾	1¼	21	9½	5¾	16¾	2¾	9	55½	5	15¾	92½	30½	204½	—

TABLE III.—DAMAGE TO OTHER TRANSMISSION AND DISTRIBUTION SYSTEMS DUE TO ENEMY ACTION.

	3 Sept., 1931 to 2 Sept., 1940	3-30 Sept., 1940	1-31 Oct., 1940	1-31 Nov., 1940	1-31 Dec., 1940	January, 1941	February, 1941	March, 1941	April, 1941	May, 1941	June, 1941	July, 1941	August, 1941	Spetember, 1941	October, 1941	November, 1941	December, 1941	Jan./Dec., 1942	Jan./Sept., 1943
Important Supplies Interrupted ..	0	68	93	104	85	47	21	64	46	68	11	7	3	3	4	4	4	47	25
Minor Interruptions	280	340	426	97	116	35	6	32	33	26	10	11	9	2	2	8	8	83	66
No Loss of Supply	17	64	82	4	—	1	—	10	4	6	0	1	—	—	—	—	1	—	2
Total Breakdowns	297	472	601	205	201	83	27	106	83	100	21	19	12	5	6	12	13	130	93
Aggregate Time Period of Interruption in Hours ..	2241	4031	5004						946	995	232								

TABLE IIIA.—DAMAGE TO OTHER TRANSMISSION AND DISTRIBUTION SYSTEMS DUE TO BARRAGE BALLOONS.

Important Supplies Interrupted ..	4	4	9	52	6	16	41	20	8	3	2	1	16	3	16	5	6	27	22
Minor Interruptions	108	159	54	64	10	25	20	9	10	3	5	3	18	1	13	17	5	73	68
No Loss of Supply	—	7	—	3	—	1	1	—	—	—	—	1	—	—	1	—	1	2	8
Total Breakdowns	112	170	63	119	16	42	62	29	18	6	7	5	34	4	30	22	12	102	98
Aggregate Time Period of Interruption in Hours ..	461	1178	374						143	28½	5								

than one occasion. In only five cases was damage to stations accompanied by interruption of supply to consumers. Supply in these cases was restored, and in other cases was maintained, directly or indirectly, by the Grid system. At the end of the month 200,000 kw of plant was out of commission under repair, 190,000 kw at Fulham and 10,000 kw at West Ham.

In this first major trial the A. R. P. protective measures taken by the supply industry and the C. E. B. proved their worth in facilitating maintenance of supply and in limiting damage. For example, the continuous production at the key station at Battersea, in spite of repeated attacks, was largely due to the precautionary and protective measures taken by the London Power Company, including the provision of a duplicate control room. The National Pool of Emergency Plant was called on, once to replace a transformer and twice for switch-gear.

The most serious incident of the month was at Fulham power station, where 190,000 kw of plant was put out of action. Littlebrook on the Thames Estuary was attacked on two successive days, but without success; the Grid substation there was hit on a later occasion.

During the month Grid lines were damaged on 125 occasions, and other lines and distribution systems on 472. Outages due to balloon barrage cables were respectively 63 and 170. For detailed analysis and periods of interruption see Tables II and III.

October, 1940

In the month of October, damage was little less severe than in September. Ten power stations in the London area were involved in incidents, and Nechells, Birmingham, the first provincial center. However, on only two occasions were supplies to consumers interrupted. At the end of the month 266,000 kw of plant was out of action, the additions to the September total being Croydon, 25,000 kw, Deptford West, 20,000 kw, and Willesden, 21,000 kw. In addition Shoreditch, 24,500 kw, and Islington, 25,750 kw were temporarily shut down on Oct. 16, the former for five days, owing to lack of water due to damage to water mains. At Deptford West, unfortunately 16 men were killed and 14 injured when a bomb fell at the South end of the boiler house, completely demolishing the auxiliary switch house and damaging the boiler house and fitters' shop. Two Grid substations were damaged, one on two occasions.

Grid lines suffered less damage from enemy action in October than in September, but there was a substantial increase in lines damaged and interruption due to barrage balloons. There were 81 outages due to enemy action, but in very few cases was supply interrupted for more than an hour. Barrage balloons caused 82 outages.

Other lines and distribution systems had the highest monthly toll of breakdowns of the whole war, 601 interruptions, including damage to 48 substations and switch stations. The latter figure compares with 52 in September. Aggregate time of outages was 5004 hours. Balloon cables caused 63 interruptions, aggregating 374 hours.

November, 1940

During this month damage to generating stations was small compared with September and October. There were no interruptions of supply from six damaged stations, five in the London area, and Hams Hall, Birmingham. A contributory cause was the extension of attacks to provincial centers, heavy raids being experienced at Coventry, Birmingham, Bristol and Southampton. No new generating sets were damaged, and with repaired plant at Fulham and Deptford West being recommissioned, the total capacity out of action at the end of the month was reduced to 176,000 kw. Three Grid substations suffered damage.

Interruptions on Grid and other lines was on a much reduced scale compared with October, 61 and 205 respectively. However, as Table III shows, there was a peak of interruptions to important supplies, 104 cases, not unnatural in view of the provincial cities assaulted. It should be noted, however, that the decrease in the numbers of reported minor interruptions in the Tables is partly due to the fact that undertakings, on instructions, did not from this time onwards report interruptions to individual or small groups of domestic premises. Damage by barrage balloon cables again caused a lot of trouble.

December, 1940

Again in this period damage to power stations and Grid substations was small compared with September and October. Damage to transmission and distribution systems was similar to November.

Six power stations were affected, five in the provinces and one in London. At the end of the month only 81,000 kw of plant remained out of commission, 60,000 kw at Fulham and 21,000 kw at Willesden.

Two Grid substations were damaged, one slightly and the other extensively, involving interrupted supply to consumers.

A marked decrease in damage to Grid lines due to enemy action occurred, the total number of such incidents for the month being 7; of these 4 affected important supplies, in the other cases there was no interruption. Damage to other transmission lines and distribution systems was on a comparable scale to November, and mainly centered in Birmingham, Sheffield, Stretford, Manchester and Liverpool, with relatively less trouble in London.

First Quarter, 1941

January opened with a recrudescence of enemy activity and damage to power stations was more severe than in either November or December. Six stations were affected, including Portsmouth, Plymouth and Bristol, and at the end of the month immobilized plant aggregated 135,150 kw, the increase being due to Portsmouth, 40,000 kw and Feeder Road, Bristol, 14,150 kw. February brought an easing of the strain, only one station, Gt. Yarmouth, sustaining slight damage. Plant out of action remained unchanged. In March there was damage to generating stations over a wide area, 14 being damaged in various parts of the country, but none of a serious or major character. Plant immobilized increased by 12,500 kw (Wallasey) to 147,650 kw.

During the three months six Grid substations were slightly damaged, one in January, two in February and three in March. Damage to Grid lines, and other lines and distribution systems were on a much reduced scale, as shown by the data in the Tables.

Second Quarter, 1941

Ten generating stations and the Admiralty Dockyard Station, Portsmouth, were damaged or affected in April. At six no interruption of supply occurred. Plant immobilized increased by 3000 kw, Bristol, 18,000 kw, Grove Road, to 154,500 kw. In May there was major damage to several of eight generating stations, the principal areas affected being Merseyside and Clyde, London and Hull. Plant out of action increased to 190,000 kw, additions being West Ham, 35,000 kw; Greenock, 19,000 kw; and St. Martin's Lane, 2500 kw. In June there was less damage than any month since September, 1940. Only one station was slightly damaged, and with one 5000 kw set back in operation at West Ham the total of plant immobilized was reduced to 185,000 kw.

During this period five Grid substations received damage, two in April, three in May, none in June.

Interruptions on Grid lines continued on a relatively low scale throughout the three months, other systems being rather more seriously involved than in the months immediately preceding. In May in particular there was much damage to substations and distribution networks as the result of the heavy raid on London on May 10-11. Liverpool, Greenock and other places also suffered considerable damage.

Third And Fourth Quarters—1941

By midsummer, 1941, it may be said that the worst was over. Raiding continued, of course, but not so severely, and although individual towns were on occasion knocked about, the defeat of the Luftwaffe was for all practical purposes complete. Few power stations were damaged and there was progressive reduction of plant immobilized from 182,000 kw at the end of July to 73,000 kw at Dec. 31, 1941. Stations that suffered during the period included Southampton, Hull and South Shields. A small number of Grid substations was also involved, but none seriously. Concerning interruptions of supply the scheduled data tell their own story.

1942 and 1943

From the standpoint of presenting a general picture, there is not much more to record. Until the advent of the flying-bomb attack in 1944, there was only desultory raiding, and such incidents as occurred, notably during the phase of sneak-raiders along the South and East coasts, had little effect on the general position of national supply, though locally serious in some cases. By the end of March, 1942, only 25,700 kw of plant remained immobilized due to enemy action; by the end of June the figure was 11,000 kw, excluding 2500 kw d.c. plant at St. Martin's Lane, which it was not intended to repair. In the next quarter, to Sept. 30, plant outage increased to 45,500 kw—Brighton 40,000 kw, and Eastbourne 5500 kw, the results of sneak raids. A year later, during which period the figure fluctuated slightly, only 15,000 kw was out of action, at Blackwall Point station of the South Metropolitan Co.

In treating this period cursorily there is no intention to minimize the severe ordeals that afflicted several individual towns, notably Exeter, Bath, Norwich, York and others, in the summer of 1942. But as already explained our concern on this occasion has been to paint only the general picture. Looking at the past four-and-a-half-years from that viewpoint, the amount of damage that the Hun succeeded in inflicting on the vital supply industry is astonishingly small.

For the data published above and in the accompanying tables, we are indebted to the Electricity Commission, who kindly placed their air-raid record files at the disposal of the Technical Press.

EEI ANNUAL CONVENTION—1945

On account of the regulations restricting meetings to 50 members where interstate travel is involved, it was necessary to postpone the Annual Meeting of the Institute previously set for the early part of June this year.

Since no modifications in travel restrictions have yet been announced it is still impractical to fix any date for the Annual Convention, but such date for the meeting will be announced as soon as conditions permit.

Eben G. Crawford

EBEN G. CRAWFORD, president of The Cleveland Electric Illuminating Company, and a member of the Advisory Committee of the Edison Electric Institute, died April 17, at Hanna House, University Hospital, Cleveland, where he had been confined by illness since April 11.

Born at Franklin, Pa., Sept. 6, 1883, Mr. Crawford attended Dartmouth college and Columbia university, and began his business career as a bank clerk in Franklin.

Mr. Crawford went to Cleveland in 1916 to take a position with Field, Richards & Company, investment bankers. In 1917 he joined the Liberty Loan organization and directed the sale of Liberty Bonds in northeast Ohio. Later he became connected with the Federal Reserve Bank, fourth district, Cleveland.

In 1921 The Cleveland Electric Illuminating Company, then initiating a period of broad expansion to meet increasing demands for electric light and power service, employed Mr. Crawford as secretary to handle financing.

During the next 10 years the company extended its system from Cuyahoga county into Lorain, Lake, Geauga and Ashtabula counties, built two new power plants and many other additional facilities, and did financing amounting to $80,000,000.

On Mr. Crawford's fiftieth birthday, Sept. 6, 1933, he was elected president, a director and a member of the executive committee of the Illuminating Company, succeeding Robert Lindsay, who had been an executive and officer of the company for 40 years.

When Mr. Crawford took office as president, Cleveland along with the rest of the country was still in the depths of the depression of the 1930's. Mr. Crawford exercised his ability and influence to help bring about recovery, and in many ways contributed to the restoration of sound basic conditions in banking and other fields. He became a director of several large concerns, including the North American Company, the Cleveland-Cliffs Iron Company and the National City Bank of Cleveland.

During the nearly 12 years that Mr. Crawford has been president of the Illuminating company, its growth has continued. In 1938 he launched a $35,000,000 construction program which put the company in a position to supply plenty of power on time to meet the enormous increases in demand created by the vast expansion of industry for war production.

Mr. Crawford was among the first to become interested in postwar planning, extended his cooperation to various organizations active in this field, and intensified the industrial development work of the Illuminating company to help create high levels of business and employment in the Cleveland and northeast Ohio area in the postwar period.

Interested in civic affairs, Mr. Crawford contributed generously of his services and financial support to many community undertakings. Notable among these was the Great Lakes Exposition, of which he was president, in 1936.

Looking forward, in the 1944 annual report of the Illuminating company, Mr. Crawford said, "Without minimizing the implications of World War II and postwar problems, we have unlimited confidence in America's future and in the ability of this company to contribute importantly to making that future secure. We expect that in the postwar era northeast Ohio will build a new prosperity on the foundations that have been laid, and that this company will continue successfully to build for northeast Ohio, and with it."

E. W. Wakelee

EDMUND WARING WAKELEE, who retired on April 16, as President of the Public Service Corporation of New Jersey, died at his home in Demarest, N. J., on April 26. Mr. Wakelee was 75 years old. Mr. Wakelee at the time of his death was a member of the Advisory Committee of the Institute.

One of the nation's leading public utility executives, Mr. Wakelee, was also a noted lawyer and prominent in civil and industrial groups. He had been president since 1939 and a director of the Public Service Corporation of New Jersey and its subsidiaries, which supply electricity, gas and transportation to more than 400 New Jersey municipalities with a combined population of 4,000,000 and employ more than 19,000 persons.

Born in Kingston, N. Y., on Nov. 21, 1869, the son of Nicholas and Eliza Ingersoll Wakelee, Mr. Wakelee attended Kingston Academy and was graduated in 1891 with honors from the Law School of New York University. In 1941 he received a Medallion Alumni Service Award for "distinguished service to the university." He had served as chairman of his class in the New Jersey Alumni Association of the university's School of Law.

The year of his graduation he was admitted to the New York bar and at once began practice. Soon he organized the law firm of Wakelee, Thornall & Wright, which continued successfully in New York for many years.

In 1900 Mr. Wakelee became counsel for the New Jersey and Hudson River Railway and Ferry Company. Eleven years later the company was leased to the Public Service Railway Company, and he became counsel to the latter. In 1914 he was made general solicitor of Public Service, and in 1917 he was chosen a vice-president and a director of the Public Service Corporation of New Jersey and subsidiary companies. He was named vice-president in charge of law in 1923, and had served also as chairman of the company's public relations committee and its executive committee.

Mr. Wakelee was elected to the State Assembly in 1899, serving as floor leader, President of the Senate, and, on occasions acting Governor.

From 1912 to 1915 he was chairman of the Republican State Committee.

Mr. Wakelee received in 1944 an honorary LL.D. degree from John Marshall College of Law in Jersey City and citation from the Junior College of Bergen County for outstanding service to the State and the nation.

He was chairman of the board of the Palisades Trust and Guaranty Company of Englewood, N. J., and a director of the Sedgwick Machine Works in New York. In addition to his connections with the EEI he was vice-president and a director of the National Association of Bus Operators, and a member of the American Gas Association, the American Transit Association, the American, State and Bergen County Bar Associations and the New York County Lawyers Association.

Indicative of his great interest in civic affairs was Mr. Wakelee's membership in the Palisades Interstate Park Commission, which maintains one of the East's largest recreational areas. He had been president of the commission since 1939. In the State Senate years earlier, he had assisted in preserving the Palisades from the encroachment of quarrymen and others.

PERSONALS

The board of directors of Wisconsin Electric Power Co. has elected S. B. WAY, formerly president, as chairman of the board and advanced G. W. VAN DERZEE from vice-president and general manager to president. The position of chairman of the board is a new one, created by action of the company's stockholders at their recent annual meeting. By the new arrangement the company retains the benefit of Mr. Way's broad experience in financial management while still granting his desire to be relieved of his duties as chief executive.

Mr. Way takes up less arduous duties after 25 years as active head of the company and its predecessor, the Milwaukee Electric Railway & Light Co. In 1898 at St. Louis a predecessor of Union Electric Co. of Missouri offered him a job as chief electrician and in 1911 he went to Milwaukee as assistant general manager of the Milwaukee Electric Railway & Light Co. in charge of the electric and heating business. The next year he was made vice-president and assistant general manager and in 1914 he became general manager. His elevation to the presidency came in 1925.

After teaching for two years in the Michigan School of Mines at Houghton, Mich., Mr. Van Derzee was associated with the General Electric Co. at Schenectady, Chicago and Milwaukee. In 1913 he joined the Electric Company in Milwaukee to assist Mr. Way. He became assistant general manager in 1918, a vice-president in 1925 and was appointed general manager in 1934. In recent years Mr. Van Derzee has been given increased responsibility in the conduct of the company's affairs, and he assumes his new duties with the benefit of this experience plus his long previous service.

GEORGE H. BLAKE was elected President of Public Service Corporation of New Jersey and subsidiary companies by the Boards of Directors of the Corporation and subsidiaries at their recent reorganization meetings in Newark.

THOMAS N. MCCARTER was re-elected Chairman of the Board and PERCY S. YOUNG, Chairman of the Executive Committee.

Mr. Blake succeeds the late Edmund W. Wakelee, President since 1939, whose retirement because of illness after many years with Public Service and predecessor companies was announced by Mr. McCarter at the annual meeting of stockholders Monday (April 16).

Thomas N. McCarter, Jr., was elected Executive Vice-President, the post held by Mr. Blake since 1943. For the past six years Mr. McCarter has been Vice-President in charge of the Company's Southern Division. All other executive officers of the Corporation and subsidiary companies were reelected or reappointed.

FREDERICK A. LYDECKER was named Vice-President in Charge of Gas Operation, Public Service Electric and Gas Company, and a Director of the Corporation's subsidiary companies succeeding John A. Clark who retires. Mr. Lydecker has been Assistant Vice-President in Charge of Gas Operation.

The new president of Public Service, George H. Blake, started with the company in 1910 as a trial attorney in Jersey City. In October, 1921, he was promoted to Assistant General Solicitor and on April 1, 1923, to General Solicitor. He was a Director of the Corporation in 1934 and a member of the Executive Committee of the Board of Directors a year later. Mr. Blake was promoted to Vice-President and General Solicitor April 20, 1937, and to Executive Vice-President August 17, 1943. He is a graduate of New York University, was admitted to the bar in 1908 and practiced law with Edwards and Smith in Jersey City prior to joining Public Service. Mr. Blake is a member of the American Bar Association, New Jersey Bar Association, the Essex Club and Baltusrol Golf Club. He is a native New Jerseyan, was born in Harrison, March 27, 1884, and lives in Llewellyn Park, West Orange.

Thomas N. McCarter, Jr., has been a director of the subsidiary companies of Public Service since 1941 and a Director of the Corporation since 1943. He is a member of the Exeuctive Committee of the Board. Prior to coming to Public Service in 1937 he was Vice-President and a Director of the Central New York Power Corporation, a subsidiary of Niagara Hudson Power Company of New York. He resigned to come to Public Service and on September 1, 1937, was made Assistant Vice-President in charge of the Southern Division of Public Service and two years later was promoted to Vice-President in charge of that division. He is a graduate of Princeton University, 1921, and lives in Moorestown.

Frederick A. Lydecker started with Public Service in 1908 as a cadet engineer in the Gas Department. In 1911 he was made Assistant Superintendent of the Summit and Morristown Gas District and a year later Superintendent of that district. He went to Newark as Superintendent of Gas Distribution, Newark District, in 1916 and was made Engineer of Distribution of Essex Division a year later. In September, 1922, he became Assistant General Superintendent of Gas Distribution and in 1926 General Superintendent. Mr. Lydecker was promoted to Assistant Vice-President in charge of Gas Operation April 18 last year. He is a graduate of Stevens Institute of Technology and lives in Glen Ridge.

Directors of the Southern California Edison Co., have elected HARRY J. BAUER chairman of the board and named WILLIAM C. MULLENDORE president. Mr. Bauer and Mr. Mullendore had been president and executive vice-president, respectively.

Mr. Mullendore became associated with the company 20 years ago. In 1929 he was appointed general attorney, vice-president in 1930 and executive vice-president in 1931, the position he occupied until his election as president.

A Southern California University graduate in law in the class of 1909, Mr. Bauer has been prominent in southern California business, civic and educational circles for a number of years. His Edison company affiliation antedates his graduation from S. C., when he entered the company's legal department. In 1918, he was appointed general counsel, and a year later resigned to enter private business. He returned to the Edison Company in 1926 as a member of the board of directors. It was in 1933 that he was made president.

In announcing the election of Mr. Mullendore as chief executive, Mr. Bauer said: "This lightening of my duties and transfer to Mr. Mullendore of the main burden of top executive responsibilities is a move which I had hoped could be made some five years ago, but at that time, with war clouds gathering, and with some rather large unfinished tasks, such as our last bond refunding, before us, it was agreed that I should remain on until a more opportune time

for the change. . . . The beginning, within this next year, of what probably will prove to be the period of reconversion and readjustment to peacetime operations, seemed a logical time for the board to call upon Mr. Mullendore to take over. My decision to retire from the presidency of the company was made much easier for me by reason of my knowledge of the high ability and complete competency of my successor . . ."

CARROLL T. SINCLAIR has been appointed Chief Engineer, Engineering and Construction Department, Duquesne Light Company.

In his new position, Mr. Sinclair will be responsible for all engineering functions, and will direct the Electrical Engineering, Mechanical Engineering, and Structural Engineering and Design Departments.

A native of Baltimore, Maryland, Mr. Sinclair was graduated from Lehigh University in 1917, with an E.E. degree in Electrical Engineering. He entered the employ of the Company on May 1, 1925, as Supervisor of Transmission a nd Distribution Engineering. Since then he has handled many general and specalized problems for the Company, additional responsibilities being given him from time to time. Prior to his recent appointment, he was serving in the capacity of Chief Distribution Engineer.

Mr. Sinclair has made many contributions to the technical press, and was editor-in-chief of the "Underground System Reference Book" published in 1931, by the National Electric Light Association.

He has served as chairman of a number of the committees of the various associations to which he belongs.

WALTER S. CHURCH was appointed Assistant General Superintendent of Construction of the Duquesne Light Company. Mr. Church was born in Bergen, N. Y. He was graduated from Rensselaer Polytechnic Institute in 1912, with a C.E. degree in Civil Engineering. Starting to work with the Engineering Department in June, 1912, he has since served in various positions, the last being Construction Superintendent, Frank R. Phillips Power Station.

Mr. Sinclair announced the appointment of five men to new positions, also effective April 2.

RALPH B. HORNER, former Design Engineer, was appointed Structural Engineer in charge of the Structural Engineering and Design Department. He will be responsible for all structural engineering and detailed design, and will direct the Structural, Electrical, Mechanical, Architectural, General, and Right of Way Divisions. He will also be responsible for drafting, blueprinting and filing.

Born in Wilkinsburg, Pa., Mr. Horner attended the University of Pittsburgh, from which he was graduated in 1916, with a B.S. degree in civil engineering. He began working for the Company on March 1, 1926, as Engineer in charge of Structural and Architectural Division. From 1932 until his present appointment, he was Design Engineer, supervising consolidated structural engineering, architectural, drafting, and blueprinting activities.

FRED J. JERNBERG was appointed Assistant Structural Engineer. He was born in Fairmont, Minn., and was graduated from the University of North Dakota in 1924, with a B.S. degree in Civil Engineering. On May 17, 1926, he began working for the Duquesne Light Company as a Junior Engineer in the Engineering and Construction Department, and from 1932 to 1936 he did construction work for the Department. He has been doing structural engineering work since then.

FREDERIC S. BROWN was made Electrical Engineer in charge of the Electrical Engineering Department. He will be responsible for all electrical engineering functions, and will direct the Station, Transmission, Distribution, Customer, and General Engineering Divisions.

Mr. Brown is a native of Lenox, Mass. He was graduated from Worcester Polytechnic Institute in 1907, with a B.S. degree in electrical engineering. Since coming with the Company on October 10, 1910, he has held various positions in the Engineering Department. The last position he held was Electrical Engineer, Stations Division.

ROBERT W. MAVITY was appointed Assistant Electrical Engineer. Mr. Mavity was born in French Lick Springs, Indiana, and was graduated from the University of Purdue, class of 1911, with a B.S. degree in Electrical Engineering. He started working for the Company in the Engineering Department on December 1, 1922. Before being made Assistant Electrical Engineer, he was a supervisor in the Transmission and Distribution Division.

R. G. RINCLIFFE has been elected vice-president in charge of electric operations of the Philadelphia Electric Company. Mr. Rincliffe entered the utility business as an engineering assistant at Chester, Pa., in 1923. Following a succession of various assignments, he was named superintendent of gas production in 1927. Four years later he was made superintendent of gas manufacturing for the entire company.

In 1938, he was named purchasing agent, continuing in that capacity until 1941, when he was appointed manager of electric station operations, the position he held at the time of his selection as vice-president.

Born in Sandusky, O., Mr. Rincliffe attended the public schools of that city. He entered Yale College in 1917, but left the following year to serve with the Navy in World War I. Returning to Yale after the war, he was graduated in 1921. In 1923, he was graduated from the Massachusetts Institute of Technology as a master of sicence in chemical engineering.

ALBERT T. O'NEILL has been appointed chief counsel for the Buffalo, Niagara & Eastern Power Corp. and its western New York subsidiaries. Assistant counsel since 1934, he is succeeding the late Warren Tubbs. Mr. O'Neill has been identified with the electric utility business for 36 years and for the past 15 has been with Buffalo Niagara & Eastern Power Corp. and its affiliated companies. Some few years ago he was president of the Bradford Electric Co., Bradford, Pa.

H. H. DINKINS, JR., has been elected secretary of Electric Bond & Share Co. and LESTER GINSBURG has been named treasurer. Mr. Dinkins has been associated with the company or its affiliates since 1927 when he joined New Orleans Public Service Inc. in a sales managerial capacity. He transferred his interests to New York in 1935 and during the last three years has been a member of the staff of Bond and Share, working on matters having to do with stockholder relations. Mr. Ginsburg was educated at Harvard College and Harvard Business School where he specialized in public utilities. In 1937 he became assistant to the president of Columbia Gas & Electric Co., in 1942 joined the War Production Board as special assistant to the Director General for Operations, Curtis E. Calder, who is now chairman

of the board of Bond and Share. For the past two years he has been making a survey of the development of the air freight and express business for domestic air lines.

At the annual meeting of the board of directors, RUSSELL G. WARNER was elected vice-president of the United Illuminating Co., New Haven, Conn.

A native of New Haven and a graduate of Yale University, Mr. Warner was employed for two years by the Westinghouse Electric & Manufacturing Co. in East Pittsburgh. Later he became a member of the faculty of the Sheffield Scientific School of Yale and was also electrical engineer of the Connecticut Public Utilities Commission.

Mr. Warner joined the staff of the United Illuminating Co. in 1939 and for the past two years has been chief engineer of the company. He is a member of the American Institute of Electrical Engineers, the Connecticut Society of Mechanical Engineers and the Yale Engineering Association. He recently became a member of the State Board of Registration for Engineers and Land Surveyors in Connecticut.

ERNEST E. DUBRY has been appointed superintendent of the central heating department of Detroit Edison Co. to succeed J. HERBERT WALKER, who was recently elected a vice-president. Other changes in central heating, recently announced by James W. Parker, president, were the appointment of RUDOLPH G. FELGER as assistant superintendent in charge of plants and coal stations, and GLENN D. WINANS as assistant superintendent in charge of steam distribution and customer relations. All three men have had many years' experience in the central heating department of Detroit Edison.

Announcement has been made by the Detroit Edison Co. of the retirement, after 45 years' service, of WILLIAM C. MILLER, superintendent of electrical system. HAROLD W. COLLINS, formerly chief assistant to superintendent of electrical system, has been appointed superintendent. DELMAR D. CHASE, who has been a member of the company's system engineering staff for several years, has been appointed assistant to superintendent.

JAMES V. CARVER, northern division engineer of the Jersey Central Power & Light Co., with headquarters at Morristown, has been transferred to Keyport as superintendent of the bay division. Mr. Carver entered the utility field with the Interstate Power Co. at Charlestown, W. Va., in 1924. The following year he became identified with the Eastern New Jersey Power Co. at Asbury Park, serving successively as draftsman, chief draftsman, assistant distribution engineer and distribution engineer. In 1936 he went to Morristown as division engineer.

N. R. SUTHERLAND, manager of the commercial department of the Pacific Gas & Electric Co., has been appointed San Francisco division manager of that utility. JAMES F. POLLARD, who since 1943, has been associated with the office of the vice-president and executive engineer of P.G.&E., will succeed Mr. Sutherland.

Replacing HENRY BOSTWICK, who is retiring from the company after 41 years of service, during 27 of which he held the position of San Francisco division manager, Mr. Sutherland has been associated with P.G.&E. since 1913. He worked in various office departments and was advanced to the commercial department, of which he has been manager since 1923.

Mr. Pollard was successively general manager and president of the Seattle Gas Co. from 1930 to 1943, following many years in the employ of the P.G.&E. and predecessor companies. A graduate engineer of the University of California, he served as engineer on the staff of the California Railroad Commission from 1915 to 1918, and for several years he was general manager of Coast Counties Gas & Electric Co. at Salinas, Calif.

Other appointments announced are:

T. W. SNELL, manager of the Coast Valleys division at Salinas, will manage the San Jose Division, succeeding I. B. ADAMS who retires after 46 years in utility company service. T. E. WARD, Richmond district manager, will succeed Mr. Snell at Salinas.

BENJAMIN J. LINDSAY, formerly right-of-way agent for the Washington Water Power Co., has been appointed secretary of that utility, succeeding L. E. MORSE, retired. Mr. Lindsay has been affiliated with the company since 1930. Mr. Morse entered the employ of the company in 1907 and had been secretary since 1929. R. B. MCELROY, who entered the employ of the utility in 1913, will be manager of dealer sales development, which will be a separate activity under the "limited" company merchandise sales policy. Mr. McElroy has held various executive positions in the sales department since 1924. A. H. WEGNER, as general commercial manager, will organize his staff to handle the general commercial functions with emphasis given to coordinated planning and supervision of customer contact and promotional activities. He was Spokane division sales manager at the time of his promotion. CARL HOFFMAN has been promoted to the position of sales manager of the Spokane division to replace Mr. Wegner. He was formerly commercial sales supervisor in the Spokane division. E. E. SCOFIELD, as wholesale and special contracts manager, will contact and handle the contracts for wholesalers, mining, and other large customers. He became affiliated with the Spokane utility in 1922. W. H. UDE, manager of the claim, tax and right-of-way department has retired. He joined the company in 1923 as superintendent of public relations.

V. D. PARROTT has been appointed lighting engineer of the Rome division of the Georgia Power Co., Atlanta. Before affiliating with the company, Mr. Parrott was assistant superintendent of city utilities for the City of Dalton. He replaces PAUL HARRISON, who resigned to become southeastern district lighting engineer of the Sylvania Electric Products, Inc., with headquarters in Atlanta.

In addition to appointments made by the Southern California Edison Co., and noted last month, the following assignments have been announced:

H. V. BUSBY, formerly assistant commercial manager, is now commercial manager. He joined the company in 1919 and has been active in its commercial organization.

L. F. HUNT, formerly senior electrical engineer, is now chief electrical engineer. J. D. ENEFER, formerly engineer, is now assistant to the manager of the engineering department. C. T. MALLOY, formerly superintendent of transmission and communication, is now general superintendent in charge of transmission, distribution and communication. C. M. CAVNER, formerly superintendent of substations, is now assistant to the manager of operation. C. E. HEATH, formerly system planning engineer, is now administrative assistant to the manager of operation. E. N. HUSHER, for-

merly assistant superintendent of distribution, is now superintendent of distribution. R. N. COE, formerly superintendent of underground, is now assistant superintendent of distribution.

P. M. MCCANN, formerly superintendent of the Long Beach district, is now assistant superintendent of distribution. G. E. MORAN, formerly assistant superintendent of substations, is now superintendent of substations.

H. L. RUDOLPH, formerly construction engineer, has been appointed assistant superintendent of substations. C. W. SANDERS, formerly assistant superintendent of transmission, now superintendent of transmission. D. Z. BIGLER, formerly supervisor of transmission, has been named assistant superintendent of transmission. A. M. BURNETT, formerly assistant superintendent of communication, is now superintendent of communication.

R. N. Conwell

ROLLIN N. CONWELL, Transmission and Distribution Engineer of Public Service Electric and Gas Company, Newark, N. J., died at his home in Bloomfield, N. J., April 14, 1945. Born at Anderson, Ind., Feb. 10, 1885, Mr. Conwell was graduated from Purdue University in 1908 and George Washington University, Washington, D. C. His first professional work was in Washington as an engineer with the Sewer Department of the District of Columbia. He was an instructor in the Army and Navy preparatory schools and a test engineer at the Bureau of Standards before going to Public Service in 1911.

Mr. Conwell was first employed as Cadet Engineer by the Public Service Electric and Gas Company of Newark, N. J.; later as Laboratory Assistant, and Chief of the Materials Division of Laboratory Testing. He was transferred to the Engineering Department as Assistant Engineer in 1917 and was in charge of station and substation design, system protection, and general engineering work. In 1922 he was made Transmission Engineer of the Distribution Department. As such he organized and placed in operation a complete system of load forecasting and planning for budget purposes. To secure a more efficient distribution of power and a better continuity of service, Mr. Conwell completely redesigned and reconstructed the transmission system of this company. In 1926 he was appointed Transmission and Substation Engineer, in which position he was also responsible for the design and maintenance of substations and switching stations. In 1938 he became Transmission and Distribution Engineer, which position he held at the time of his death. During this period he was engaged in the supervision of load forecasting, system planning, transmission, substation and distribution design, operation and maintenance.

Mr. Conwell's inventions included various electrical relay systems now commonly used throughout the country, and he had done outstanding work in the inductive interference field.

Prominent in national engineering activities, he served on many technical and administrative committees in the American Institute of Electrical Engineers, the Edison Electric Institute, the American Standards Association, the National Fire Protection Association, and the Association of Edison Illuminating Companies. In 1922-24 he was Chairman of the EEI Inductive Coordination Committee; in 1929-32 he was Chairman of the AIEE Power Transmission and Distribution Subcommittee on Steel Towers and Conductors; in 1930-31 he was Chairman of the AEIC High-Tension Cable Subcommittee on Specifications for Varnished Cable; in 1933-35 he was Chairman of the AIEE Program Committee and the Committee on the Award of Institute Prizes; in 1935-37 he was Chairman of the AIEE Committee on Constitution and By-Laws. His contributions to technical literature and discussion have been abundant.

Especially interested in personnel relations with younger men, Mr. Conwell devoted himself to the Cadet Engineer educational program in Public Service Electric and Gas Company. He was also active in the Boy Scout movement and had been President of Tamarack Boy Scout Council.

The Proposed MVA

(*Continued from page* 136)

power of the Secretary of the Interior would be multiplied super-power.

As I stated in the beginning, the Mississippi Valley Committee and the National Resources Planning Board submitted voluminous reports. Nothing was accomplished. The planning idea died a natural death when Congress repudiated the National Resources Planning Board. Nothing had been accomplished except to spend a lot of money uselessly. No reclamation project was proposed that had not been approved by the Bureau of Reclamation. No flood control project or program was recommended that had not been studied and approved by the Corps of Engineers.

The substitute, with all deference, is really worse than the Missouri River Valley Authority or any other authority proposed. It would establish the super-bureaucracy of all time for lump sum appropriations without Congressional approval or scrutiny. It would scrap the established agencies of the government intended for the benefit of all for the benefit of a few. It would give the Secretary of the Interior, whose improvements are largely confined to reclamation works, authority for flood control and other internal improvements in all of the states, whereas his reclamation activities have been confined to the comparatively few arid states of the Union. The substitute is urged to provide coordination. It might better be used to provide for abolition. The work of the Corps of Engineers could be abolished. Their splendid plans could be wrecked. The Forest Service and the Soil Conservation Service could be abolished. If the criticism by Secretary Ickes of the Murray Bill that it would scrap reclamation is sound, I submit that his substitute would scrap the helpful and constructive provisions made by Congress for flood control, reclamation and reforestation and other allied activities by other departments of the government.

Existing flood control acts provide for cooperation between the War Department and the Department of Agriculture. The latest act extends that cooperation and provides for cooperation between the Corps of Engineers and the Bureau of Reclamation. That act was not opposed by the Secretary of the Interior. No additional agencies were suggested in the Flood Control Act of 1944 to provide for such cooperation. The cooperation exists, and the remedy is not to scrap or to destroy existing agencies but it is for the Chief Executive and the Congress to insist upon the cooperation and coordination provided by existing legislation.

We have had enough theoretical planning, enough lump sum appropriation. It is time to plan for the building of the flood control works and the reclamation works authorized by Congress for construction following the cessation of hostilities.

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(Continued)

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